Anticipating criminal behaviour

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ANTICIPATING CRIMINAL BEHAVIOUR

USING THE NARRATIVE IN CRIME-RELATED DATA

Wer nicht von dreitausend Jahren sich weiß Rechenschaft zu geben,
bleib im Dunkel unerfahren, mag von Tag zu Tage leben.

(He who cannot draw on three thousand years, is living from hand to mouth)

J.W. von Goethe

Peter A. M. G. de Kock

ANTICIPATING CRIMINAL BEHAVIOUR

USING THE NARRATIVE IN CRIME-RELATED DATA

PROEFSCHRIFT

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Preface

This thesis is the result of a rather unorthodox combination of fine art, law enforcement, and science. The enumeration of these disciplines reflects the development of my scientific career.

In 1990, as a student at the Film Academy of the Amsterdam School of the Arts, I became engaged in a dispute with one of my lecturers over the metaphysical quality of narratives. He claimed that any imaginable narrative could be created by a handful of scenario components, and I was challenged to compile a limitative list of these components from all the narratives that were to be studied during the four-year course.

In 2007, after a career as filmmaker and director of documentary films that spanned more than fifteen years, I applied for a Master of Criminal Investigation. To complete my study, I wrote a master thesis on the concept of applying a narrative approach (based on the aforementioned scenario components) to anticipate terrorist attacks. The publication of this dissertation resulted in an invitation by the Royal and Diplomatic Protection Service (DB&B) of the Dutch National Police[1], to pursue the proposed concept in operational and real-life situations.

As the team leader of a covert unit, I was able to introduce an innovative method of close protection. Instead of re-acting to the moves of our adversaries and trying to withstand an attack, we predicted their moves and tried to prevent an attack. First, we analysed historical data to acquire "the narrative" of our adversaries. Next, we created a "counter-narrative" that would alter the developments to our benefit. Once we had defined the narratives in detail, we designed covert operations to intervene accordingly.

The results of my team were thought provoking and prompted the interest of counter-terrorism and intelligence organisations. I was invited to demonstrate the method of operation to prominent members of Dutch Parliament and the Ministry of Security and Justice.

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[1] During the realisation of this Ph.D. research, the regional police forces of the Netherlands were incorporated into one national police force. In this thesis we consistently use the current nomenclature.

Following one of these presentations, I was offered the opportunity to pursue the use of scenarios to anticipate crime, in a Ph.D. study at Tilburg University. The idea to converge art, law enforcement, and science in the development of a new scenario model was a thrilling perspective and became the start of a journey that ends here, with the completion of this thesis.

Without the help of many organisations and people, this thesis would not have been possible. Here, I would like to take the opportunity to express my gratitude to them.

First and foremost, I would like to thank my supervisors for their support and detailed advice during this Ph.D. research. I have had the honour to receive guidance from Jaap van den Herik, Jan Scholtes, and Pieter Spronck. Their support and belief in me have been a crucial factor in the completion of this thesis.

Furthermore, I would like to extend my gratitude towards the following organisations. Tilburg University for granting me the opportunity to pursue my Ph.D. study. The Graduate School of Tilburg School of Humanities (TSH), and the Tilburg centre for Cognition and Communication (TiCC) for receiving me with hospitality, and for allowing me to work with their students. I would like to thank Utrecht University, in particular the department of History of International Relations, for entrusting me a talented Master student. Furthermore, I owe gratitude towards ZyLAB for their guidance and assistance in discovering the potential of text mining. Finally, I would like to thank The National Coordinator for Security and Counterterrorism, and the International Centre for Counter-Terrorism for their support.

Additionally, I would like to thank three students whose contributions have proven to be a valuable part of this thesis: Liesbeth van der Heide, Linda Stege and Sophie Bressers.

My Ph.D. research has been accompanied by an advisory board, which I wish to thank for their critical and supporting advice.

- Ms. P.M. Zorko (Chief constable of the Central division of the National Police of the Netherlands)
- Mr. A.H. van Wijk LLM (Board of Prosecutors General)
- Mr. E.C. Mac Gillavry LLM (Deputy director of Bureau for Criminal Law Studies Dutch Public Prosecution Service)
- Mr. E.S.M. Akerboom (Secretary-general of the Ministry of Defence), who I would like to thank in particular, as he was (in his capacity of Chair of the NCTv) one of the first people to recognise potential in my attempts to thwart an attack on his life during the exercise *Purple Haze III*[2].

Moreover, I would like to thank the members of my thesis committee, for their preparedness to read this thesis and to assess it to the best of their abilities: Prof. dr. A. Plaat, Prof. dr. E.O. Postma, Prof. mr. T.A. de Roos, Prof. dr. B.A. de Graaf (Beatrice), and Prof. dr. B.G.J. de Graaff (Bob).

Most importantly, I would like to thank my employer, Central division of the National Police of the Netherlands for allowing me the professional space to come up with new and unusual ideas. In particular, I would like to thank Mr. R.G.C. Bik (Deputy commissioner of the National Police of the Netherlands) and Ms. P.M. Zorko, (Chief constable of the Central division of the National Police of the Netherlands), for encouraging me on this journey.

Apart from the organisations and people mentioned in this section, there is a number of people whose support has been essential in the completion of this thesis. Because my appreciation for them transcends the merits of a preface, I have dedicated a special section to their acknowledgements (see page 355).

Peter de Kock
Amsterdam, 2014.

[2] *Purple Haze III* refers to a red-team exercise that was designed by the DB&B of the Dutch National police.

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List of abbreviations

AI	Artificial Intelligence
AIVD	Algemene Inlichtingen- en Veiligheidsdienst (General Intelligence and Security Service)
CIA	Central Intelligence Agency
CBR	Case-based Reasoning
CBRN	Chemical, Biological, Radiological, and Nuclear
COT	COT Instituut voor Veiligheids- en Crisismanagement
CSV	Comma separated value
DB&B	Dienst Bewaken & Beveiligen (Central Security and Protection Service)
DLR	Dienst Landelijke Recherche (National Crime Squad)
DSI	Dienst Speciale Interventies (Special Interventions Service)
ELN	Ejército de Liberación Nacional
EPL	Ejército Popular de Liberación
ESC12	The twelve Elementary Scenario Components
ESC6	Six of the ESC12 that are used for the research performed in chapter eight
ESP	Experimental Scenario Platform
FARC	Fuerzas Armadas Revolucionarias de Colombia
FARC-EP	Fuerzas Armadas Revolucionarias de Colombia – Ejército del Pueblo
GTD	Global Terrorism Database
HUMINT	Human Intelligence
IBDCWG	International Bomb Data Centre Working Group
IED	Improvised Explosive Device
IT	Information Technology
IRS	International Revenue Service (IRS)

KDD	Knowledge Discovery in Databases (also referred to as Data-mining)
LE	Landelijke Eenheid (Central Division of the Dutch National Police)
LEA	Law-enforcement agency
MAD	Mutually Assured Destruction
MID	Military Intelligence Directorate of Israel
NCTv	Nationaal Coördinator Terrorismebestrijding en Veiligheid (National Coordinator for Security and Counterterrorism)
n.d.	No date
NFA	Nederlandse Filmacademie (Netherlands Film Academy)
NGO	Non Governmental Organisation
NP	Nationale Politie (Dutch National Police)
OSINT	Open-source Intelligence
RAND	RAND Cooperation (Research ANd Development)
SLA	Symbionese Liberation Army
SVM	Support Vector Machine
TED	Technology Engineering and Design
TPC	Terrorist Planning Cycle
US	United States
VNSA	Violent non-state actor

List of definitions

List of illustrations

List of boxes

1

Where there is no narrative, there is no history.
Benedetto Croce[3]

ONE | Finding the narrative

This chapter introduces the reader to the objectives and scope of the thesis. It formulates the problem statement, and four research questions, and constitutes the research framework for our study.

[3] Benedetto Croce (1866 - 1952), historian, humanist, and foremost Italian philosopher of the first half of the twentieth century. The quote of Croce cited above, appeared in *A theory of Narrative* (Altman, 2008).

A narrative, according to the Oxford English dictionary, is any account of connected events, presented to an audience in a sequence of written or spoken words, or (moving) pictures. Narratives play an important role in human life. As soon as children learn to speak, they demand to be told stories in the form of narratives. They help us to understand the world around us, and to grasp complex concepts such as ethics and morality. From childhood onwards, a substantial amount of human life is spent listening to narratives, reading narratives, or watching them being acted out on television or cinema screens. Much of our conversation is taken up with recounting the events of daily life in the shape of a narrative. Narratives help us to remember past experiences and to relate them to other human beings (cf. Tulving, 1985).

The need for narrative is rooted so deep in human existence that narratives are at the mainstay of entertainment, law, and politics. News is presented as narratives (cf. Booker, 2004), justice is administered because of narratives (cf. Van Koppen et al., 2002), and wars are waged on the basis of narratives (cf. Schwalbe, Silcock, & Keith, 2008). Moreover, history is recorded and related in the shape of narratives (cf. Booker, 2004). While the words of Croce cited at the beginning of this chapter might seem grotesque, the Latin word "historia" translates as "narrative of past events"[4].

The terrorist attacks in Washington and New York at the start of this millennium, fuelled an interest in using the narrative to anticipate criminal behaviour. US Government authorities invited film producers, scenario writers, and developers of computer games, to come up with the narrative of the next possible terrorist attack (cf. Edwards, 2001). More recently, the CIA declared its interest in finding the narrative in "big data"[5] to be able to detect deviant behaviour (cf. Novet, 2013).

While the dictum of Croce "Where there is no narrative, there is no history", emphasises the importance of the narrative, "Find the narrative and anticipate the future" seems to be the aphorism of the next decennium. Though, the issue of

[4] "history"; Online Etymology Dictionary.

[5] "Big data" is defined as "high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making" (Gartner, 2013).

how a narrative can be generated and subsequently be used to anticipate criminal behaviour, is something that has yet to be investigated.

In the creative sector, a narrative is generated by a *scenario* that describes the interactions between characters. It includes information about behaviour, goals, motivations, modi operandi, and resistances that have to be overcome (Saaltink, 1990). Over the last decennia, commercial companies have adapted creative scenarios as a powerful tool to anticipate future behaviour and to foresee the actions and strategies of competing companies. Questions such as "What makes the competitor resilient?", "What makes a company survive major technical or political shifts?", and "Would it be possible to foil the next move of a competitor?" are successfully answered by the use of scenarios (cf. Porter, 1985; Ringland, 2006).

Yet, while scenarios are widely used to help commercial organisations anticipate the next move of their competitor (cf. Hamel & Prahalad, 1994), little attention has been paid to the possibilities of scenario planning in anticipating the actions of illegal organisations. This guided us to the question: would a scenario model prove as useful a tool to anticipate the behaviour of a criminal organisation as it proved to be in anticipating the behaviour of a commercial organisation?

We found many scientific studies that have been devoted to criminal behaviour in general (e.g., Matza & Sykes, 1961; Hacker, 1976; Cohen & Felson, 1979; Brantigam & Brantigam, 1981; Cornish & Clarke, 1986; Lissenberg et al., 2001; Boetig, 2006). Additionally, we found many scientific studies that have been devoted to scenario-based anticipation models in general (e.g., Kahn & Wiener, 1967; Ducot & Lubben, 1980; Duncan & Wack, 1994; Hamel & Prahalad, 1994; Godet & Roubelat, 1996; Van der Heijden, 1996; Kenter, 1998; Armstrong, 2001; Postma & Liebl, 2003; Ringland, 2006; Van Notten, 2006; Chermack, 2011). However, we found no evidence that scholarly research has been devoted to the use of scenario-based anticipation models in the anticipation of criminal behaviour.

The research objective of this thesis is to investigate to what extent a scenario model can support law-enforcement agencies in the anticipation of criminal behaviour.

The current chapter introduces the reader to the topic of anticipating criminal behaviour and provides the essential elements for our research. Section 1.1 constitutes a brief introduction to the topic, while in section 1.2 the research objective is explained. Section 1.3 addresses the significance of the research, and section 1.4 defines the scope of the study. In section 1.5 the problem statement is formulated which will guide the investigation. Subsequently, four research questions are presented that partition the research in a proper way. Section 1.6 delineates our research methodology and section 1.7 provides the structure of the thesis. Finally, section 1.8 calls attention to ten publications that are closely related to this thesis.

1.1 Anticipating criminal behaviour

The word "anticipate" originates from the Latin *anticipare* which translates as "to act in advance". It is based on *ante-* "in advance" and *capere* "to take"[6]. The contraction of both words essentially reflects the central aim of this thesis; to create a model by which information can be used for analysis and proactive use. "Ante" in the context of this study represents pro-activity; behaviour that involves acting in advance of a future situation, rather than reacting. "Capere" in turn, represents the process of analysis; of breaking a complex topic into smaller parts in order to gain ("to take") a better understanding of it.

Because "anticipation" is a complex phenomenon that is rooted both in past experience, and in expectations of what is about to happen, we provide a stipulative definition below.

Definition 1.1: Anticipation

Anticipation is the concept of making decisions concerning future events in a timely and effective fashion, based on the interpretation of past events.

Moreover, we define criminal behaviour as follows.

Definition 1.2: Criminal behaviour

Criminal behaviour is any human conduct that has the intent to (or results in the commission of) an unlawful act.

6 "anticipate"; The Oxford Dictionary of English Etymology.

Understanding crime is the subject of chapter two where we will define "crime" (definition 2.1), "organised crime" (definition 2.2), and provide a deeper understanding of the predicaments of criminal behaviour. However, for the appreciation of definition 1.2, and consequently the problem statement and corresponding research questions of this thesis, it is sufficient to note that "law" in our society is defined by social and legal institutions, not by technology or biology (cf. Koelewijn, 2009).

With regard to the concept of a scenario model able to anticipate criminal behaviour, we would like to emphasise that by no means, we suggest that a scenario model will be able to predict (and react to the prediction of) criminal behaviour by itself. The scenario model that we propose, aims to assist human operators in the process of anticipating criminal behaviour. An illustration of the relation between the processing of crime-related data and the understanding of that data is given in box 1.

Box 1: Digression on a computer scenario model

A computer scenario model may be able to process large volumes of crime-related data, and rank scenarios on the basis of likelihood, but it will not be able to *understand* criminal behaviour. Obviously, to this day and age computers lack the common sense, or knowledge in the form of intuition, that domain experts possess. Moreover, as the early days of artificial intelligence have learned (see Russel & Norvig, 2010), such common sense or expert knowledge is quite difficult, if not impossible, to program into a computer algorithm.

Therefore, we would like to proceed by stating that (a) the scenario model and corresponding algorithms that we propose and investigate, will merely be responsible for the tasks that require cognitive processing power, and (b) a human domain expert will ultimately be responsible for the interpretation of the output of the scenario model. Changes with respect to (a) and (b) may happen in the future, but they are beyond the scope of this thesis.

1.2 Research objective

The general objective of this thesis is, as stated above, to investigate to what extent a scenario model can support law-enforcement agencies in the anticipation of criminal behaviour.

Although the research presented in this thesis may be applicable to other domains such as regulatory agencies that act in the area of administrative law, cyber security, fraud detection, or financial regulations, the investigations were guided by the challenges faced by law-enforcement agencies in the anticipation of crime. Therefore, as a guideline for the reader, we will present a definition of law-enforcement agency below.

Definition 1.3: Law-enforcement agency
A law-enforcement agency (LEA) is a government agency responsible for the enforcement of the laws.

While the majority of studies of the use of scenarios are exploring the relationships between a set of concepts, testing hypotheses, and forming theories, we intend to contribute to the discussion on anticipating criminal behaviour by two specific research activities, viz. (i) studying the design, development, and use of an anticipative scenario model, and (ii) assessing its potential to analyse and anticipate criminal behaviour.

1.3 Scientific relevance

Attaining the research objective mentioned in section 1.2, will lead to at least three scientific contributions, viz. (1) developing a new specialised area of research, (2) identifying critical components of crime and correlating them, and (3) devising a new, practical methodology in which scenario planning is applicable. Below, we will briefly discuss these scientific contributions.

1 Developing a new specialised area of research
The possibilities of anticipative scenario models in law enforcement are emerging as a new domain in scientific research. So far, extensive research has been devoted to anticipating techniques and scenario mapping in general (e.g., Kahn & Wiener, 1967; Hamel & Prahalad, 1994; Godet & Roubelat, 1996; Van der Heijden, 1996; Kenter, 1998; Armstrong, 2001; Postma & Liebl, 2003; Nekkers, 2006; Ringland, 2006; Van Notten, 2006; Chermack, 2011). However, the development of an anticipative scenario model within the domain of law enforcement is far from obvious. This thesis will investigate and summarise literature on scenario mapping and apply that knowledge in the development of a scenario model able to

anticipate criminal behaviour. By developing a model that combines practical data from different criminal organisations with theoretical knowledge about criminal acts, this study contributes to the discussion of Intelligence Led Policing and Security[7] and provides law-enforcement agencies with the design of a scenario model that can be used on strategic, tactical, as well as operational level.

2 Identifying critical components of crime and correlating them

Scholarly literature in the field of terrorism largely takes a fragmented approach, focussing on isolated aspects of terrorism or on single terrorist attacks. When addressing the problem statement, we will propose a design for a scenario model in which detailed information of different criminal incidents can be combined. By accumulating data from individual cases, this research can help to identify the crucial components of crime as well as to define the correlation between these components.

3 Devising a new, practical methodology

This study intends to devise a practical methodology in which historical data of criminal incidents can be collected for comparison and critical evaluation. As we will argue, a scenario model applied to the field of law enforcement can externalise and codify knowledge of individual cases and make that data readily available. Moreover, a scenario model may capitalise on this historical data to generate new and plausible scenarios of future criminal behaviour.

Scientific studies in which anticipative scenario models are combined with criminal behaviour are scarce. Seemingly non-existent is scientific research that combines anticipative scenario models with the application of data- and text-mining techniques in order to anticipate criminal behaviour.

By studying to what extent an anticipative scenario model can support law-enforcement agencies in the analysis and anticipation of criminal behaviour, this research intends to (a) fill the lacunae of scientific research in the field, and (b) create a foundation for further research.

[7] Intelligence-led policing is a business model and managerial philosophy where data analysis and crime intelligence are pivotal in an objective, decision-making framework that facilitates crime and problem reduction, disruption and prevention through both strategic management and effective enforcement strategies that target prolific and serious offenders (cf. Ratcliffe, 2008).

1.4 Restrictions of research

"Criminal behaviour" is a broad concept. In order to evaluate the design, development, and use of a scenario model able to anticipate criminal behaviour, we narrowed the scope of our study. This constitutes restrictions of our research. Below, we will narrow the scope of the study by addressing the following issues: the object of inquiry (subsection 1.4.1), the time of inquiry (subsection 1.4.2), the scale of inquiry (subsection 1.4.3), and the classification of information (subsection 1.4.4).

1.4.1 The object of inquiry

In this thesis we assume that a scenario model can be designed that may be used to anticipate criminal behaviour. To test this assumption, we decided to document and evaluate the design, development, and usability of a scenario model able to anticipate criminal behaviour. To test the scenario model proposed in this thesis, we will create an Experimental Scenario Platform (ESP) in which the scenario model will be linked to a dataset that comprises a subset of criminal behaviour; that of terrorism. This data subset constitutes an important restriction of our research.

Terrorism as we believe, is a phenomenon that is sufficiently complex to be used as a testing ground for the proposed scenario model. Yet, it is also suitably concise to extract a finite number of incidents relevant for the assessment of a scenario-based anticipatory technique.

1.4.2 The time of inquiry

When addressing the subject of a scenario model able to anticipate future incidents, "the future" has to be specified. After all, the future is infinite by nature. For a realistic anticipation of future criminal incidents, this study uses a timeframe of up to (approximately) one year. For such a period, a certain amount of linearity and extrapolative forecasting can be assumed (cf. List, 2005).

1.4.3 The scale of inquiry

The proposed scenario model is not designed for anticipating behaviour on a global level such as behaviours of states or countries. Although the scenario model may be more generally usable, our inquiry focusses on anticipating behaviour of a relatively small social or cultural unit, e.g., a person or an organisation.

1.4.4 The classification of information

Good practice of scientific inquiry requires that the data and the methodology are well documented and made public (see NWO, 2012). To evaluate the design, development, and use of the scenario model, we will create an ESP in which we will combine the scenario model with data obtained from open sources such as international studies, declassified reports, newspaper clippings, radio, and television reports. The fact that this data is not validated, has to be recognised in the evaluation of the ESP. This open-source environment allows us to focus our attention on the performance of the ESP and effectively, on the performance of the scenario model.

1.5 Problem statement and research questions

Our research is guided by a problem statement (PS) and four research questions (RQs). In subsection 1.5.1 we formulate the problem statement. Subsequently, in subsection 1.5.2 we articulate the four research questions.

1.5.1 Problem statement

Section 1.1 indicated that the use of scenarios models has proved to be valuable in anticipating future behaviour of commercial organisations. The section also indicated that the possibilities of a scenario model in aiding law-enforcement agencies to anticipate criminal behaviour, is a subject that apparently has been neglected, also by academic research.

While relevant data and insights can be found in literature on crime and criminal organisations, information on the use of scenario models has not been collected and systematically analysed to assess its value in anticipating future events (cf. Jackson, 2005). Moreover, application of data- and text-mining tools may enhance the anticipation, prediction, and even prevention of crime (see McCue, 2007) and allow for a new form of law enforcement in which intelligence is gathered by data-mining tools (see Vanderlooy, 2009).

Therefore, the question mentioned at the beginning of this chapter, "would a scenario model prove as useful a tool to anticipate the behaviour of a criminal organisation as it proved to be in anticipating activities in a commercial context?"

is fundamental in this research. This question brings us to the problem statement to be discussed in this thesis. It reads as follows.

Problem Statement:

To what extent can a scenario model support law-enforcement agencies in the anticipation of criminal behaviour?

1.5.2 Four research questions

To answer the problem statement, we formulate four research questions that guide our research work. We start establishing our point of departure by RQ1.

Research Question 1:

What does literature on scenario-based anticipation methods offer that is relevant for the development of a scenario model by which criminal behaviour can be anticipated?

RQ1 aims to review the existing literature on scenario-based anticipation methods and to utilise the findings to guide the design and development of a new anticipative scenario model for use in law enforcement.

To be able (a) to document the design and development of a scenario model able to anticipate criminal behaviour, and (b) to test the capabilities of such a scenario model accordingly, we formulate RQ2.

Research Question 2:

To what extent can a scenario model be designed by which criminal behaviour can be anticipated?

The first step in the anticipation of future incidents is the analysis of historic incidents (see section 1.1). A scenario model by which historic criminal behaviour can effectively be analysed, would offer a valuable tool for law-enforcement agencies and can in virtue be used for any task in which it is important to study the communalities and differences between idiosyncratic criminal incidents. To test the analytical capabilities of a scenario model able to anticipate criminal behaviour, we formulate RQ3 as follows.

Research Question 3:
To what extent can a scenario model be used to analyse historic criminal behaviour?

The second step in the anticipation of future incidents is to use the findings from analysing historic incidents and to extrapolate these findings into the future. Data mining provides tools (classifiers) that can be used to facilitate this process and generalise observations to make predictions in the near future (see Vanderlooy, 2009). To be able to test the extent to which a scenario model can be used to anticipate new and unseen incidents, we defined RQ4 that reads as follows.

Research Question 4:
To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law-enforcement agencies to anticipate criminal behaviour?

The answers to the four research questions will allow us to formulate an answer to the problem statement.

1.6 Research methodology

To document and evaluate the design, development, and usability of a scenario model able to anticipate criminal behaviour, we employ an inductive research methodology which consists of five stages: (1) review and analyse the literature, (2) design a new scenario model, (3) create an Experimental Scenario Platform (ESP), (4) perform experiments with the ESP, and (5) analyse the obtained results. In table 1.1 an X indicates which methodology stages are employed to address each of the four research questions and the problem statement of this thesis. Below we will discuss the five stages.

Methodology stages	RQ1	RQ2	RQ3	RQ4	PS
1 Review and analysis the literature	X				
2 Design a new scenario model		X			
3 Create an Experimental Scenario Platform (ESP)					
4 Perform experiments with the ESP			X	X	
5 Analyse the obtained results					X

Table 1.1 Overview of the research methodology.

1 Review and analyse the literature

Literature review is at the base of our research. Studying the literature on predictive anticipatory techniques will provide an overview of scenario-based anticipation methods in the broadest sense of the word. Our literature review will include scholarly articles, books, and other sources (e.g., dissertations, industrial reports, articles on related research). We are interested in various techniques and approaches to scenario-based anticipation methods ranging from scientific models designed to calculate uncertainties in the future, to scenario models used in creative writing. Our goal is to offer an overview of significant contributions from the literature and to provide a solid basis for the design of a scenario model fit for anticipating criminal behaviour. Effectively, the literature review and analysis will be the foundation of the answer to RQ1.

2 Design a new scenario model

Based on the findings of our literature review, we will design a new scenario model by which (i) criminal behaviour may be modelled, and (ii) future criminal behaviour may be anticipated. The design of the scenario model will encompass (1) a conceptual design in which we will explore the hypothetical function of the model, and (2) an architectural design in which we will study the implementation of the modules that constitute the model and the processes that these modules facilitate.

3 Create an Experimental Scenario Platform (ESP)

To address RQ3 and RQ4 effectively, we require a test model or Experimental Scenario Platform (ESP). The ESP is based on the design of the scenario model proposed in the previous methodological stage and combines the conceptual design of the scenario model with an actual dataset that comprises a subset of criminal behaviour, viz. that of terrorism. Subjecting the ESP to experiments allows us to assess the robustness of the proposed design of the scenario model.

4 Perform experiments with the ESP

The fourth step of our methodology consists of subjecting the ESP to different experiments. These experiments provide the empirical results needed to evaluate the performance of the proposed scenario model. We will measure the effect of the scenario model by concentrating on (a) the analysis of historical incidents, and (b) the ability to anticipate future incidents, which effectively will lead to answering RQ2 and RQ3. The evaluation of the performance of the ESP will be done by two corresponding measurements that we will briefly describe below.

Analysis of historical incidents
To measure the capabilities of the ESP in the analysis of historic incidents, we measure its performance in detecting a "time-independent profile" for lone-operator terrorism and evaluate the results. The evaluation of the performance of the ESP effectively will lead to the answer of RQ2.

The ability to anticipate future incidents
To measure the capabilities of the scenario model to anticipate future behaviour, we will add data-mining tools to the scenario model. Moreover, we will investigate how well the ESP performs in predicting new and unforeseen incidents based on historic cases. The evaluation of the performance of the ESP to anticipate future incidents, will lead to answering RQ3.

5 Analyse the obtained results
Having performed the aforementioned experiments, we will complete our research by analysing the obtained results. In this stage we will accumulate the outcomes of the previous stages and answer the problem statement.

1.7 Structure of thesis

The problem statement and the four accompanying research questions introduced in section 1.5 are investigated over the course of 11 chapters. In table 1.2 the chapters that address the research questions and problem statement are denoted by an X. Below we will provide a brief description of each chapter.

Chapter	RQ1	RQ2	RQ3	RQ4	PS
1 Finding the narrative	X	X	X	X	X
2 Understanding crime					
3 Using scenarios	X				
4 Modelling criminal behaviour: ESC12					
5 Designing an ESC12 scenario model		X			
6 Creating the ESP PANDORA					
7 Developing the ESP PANDORA					
8 Opening PANDORA's box			X		
9 Discovering PANDORA's box				X	
10 Conclusions	X	X	X	X	X
11 Deleted scenes					

Table 1.2 Overview of the structure of the thesis.

Chapter 1 Finding the narrative

Chapter one constitutes the introductory chapter. It sets the background and structure of the study. We define the concept of anticipating criminal behaviour and introduce our research objective. Subsequently we mention the scientific relevance and restrictions of our research. Based on these outlines, a problem statement and four corresponding research questions are formulated. Moreover, we describe the employed research methodology and provide an overview of the thesis. The chapter is concluded by an overview of the publications that are related to this thesis.

Chapter 2 Understanding crime

Chapter two forms the theoretical basis for our study. It focusses on the overarching theme and provides a deeper understanding of crime in general and criminal behaviour in particular. Drawing on literature from (i) criminology, (ii) terrorism research, and (iii) organisational learning, the predicaments of criminal behaviour are studied. We start by defining the concept of crime and highlight three criminal theories that offer insight into the predicaments of crime relevant to the design of a scenario model able to anticipate criminal behaviour. Subsequently, we describe the relation between organised crime and terrorism, and provide definitions of both these terms. Next, we focus on "lone-operators"; criminals that operate without an organisational structure. Finally, because criminology indicates that a common denominator of both criminal and terrorist organisations is their ability to learn, we conclude chapter two by a description of the concept of organisational learning and the opportunities it offers to anticipate criminal behaviour. The output of this chapter will contribute to the design of an ESC12 scenario model in chapter five.

Chapter 3 Using scenarios

Chapter three aims to answer RQ1 and constitutes a literature review of scenario-based anticipatory techniques. The chapter starts by defining the terms relevant to the use of scenarios in anticipating future behaviour. Next, we review the history of scenario planning and the development of scenarios. We focus on the use of creative scenarios and the concept of the twelve components by which a scenario may be constructed. Subsequently, three proactive models that are in use in law enforcement are discussed to illustrate the difference with an anticipative scenario model. Then, the limits of anticipating future events are addressed and the most valuable methods in relation to this thesis are highlighted. We conclude the chapter by answering RQ1, and by focussing on the relevant findings that emerged in our literature review. The outcome of chapter three will contribute to the modelling of criminal behaviour in chapter four, and to the design of an ESC12 scenario model in chapter five.

Chapter 4 Modelling criminal behaviour: ESC12

The research required to formulate an answer to RQ2, is split over the chapters four and five. Chapter four builds on the input of chapter three. First, we propose a novel manner of modelling criminal behaviour based on the components by which creative scenarios are constructed. We focus on the relation between a criminal offence and a theatrical performance and present a definition of the *twelve Elementary Scenario Components* (ESC12). Next, we list the ESC12 and illustrate them by using two stories: (i) the early oral history of *The epic of Gilgamesh* and (ii) the blockbuster motion picture *Jaws*. Subsequently, we introduce the ESC12 to the area of law enforcement by relating them to "the Golden W's", a concept that is frequently used in the process of information gathering in law-enforcement investigations. We study the communalities and differences between the ESC12 and "the Golden W's" and arrive at the conclusion that the ESC12 offer an effective and durable set of components to describe, characterise and model a criminal incident. Based on this conclusion, we will decide to implement the ESC12 in the design of a scenario model able to anticipate criminal behaviour, which constitutes the subject of chapter five.

Chapter 5 Designing an ESC12 scenario model

In chapter five we aim to answer RQ2 and present the design for an innovative scenario model, based on the ESC12. This chapter draws on the results of the chapters two, three, and four, and, in essence, forms the heart of the thesis. The chapter starts by proposing a definition of the ESC12 scenario model. Subsequently, we illustrate the conceptual design of the ESC12 scenario model by focussing on the use of the ESC12 in (i) the ability to learn, (ii) the ability to adapt, and (iii) the ability to anticipate. Next, we propose an architectural design of the ESC12 scenario model that constitutes four modules (viz. a data cruncher, a scenario matrix, a controller, and a scenario generator) and facilitates six processes (viz. *Data pre-processing*, *Data warehousing*, *Facilitating differentiated output*, *Generating differentiated output*, *Feedback* and *Applying knowledge*). Subsequently, we explain how these modules and processes interact with one another. We conclude this chapter by presenting a blueprint of the architectural design of the ESC12 scenario model. To assess this design, an experimental scenario platform needs to be constructed. This will be the subject of the chapter six.

Chapter 6 Creating the ESP PANDORA

Chapter six constitutes the creation of an Experimental Scenario Platform (ESP) named PANDORA in which data of criminal behaviour is added to the architectural design of the scenario model proposed in chapter five. In the creation of the ESP, we observe that the ESC12 represent categories too broad and general to encompass the relevant details of a criminal incident. Therefore, we subdivide the ESC12 into 98 variables and introduce four types of values for each variable (viz. dichotomous value, numerical value, categorical value, and text value).

To be able to address RQ3 and RQ4 adequately, we require two separate ESPs. For RQ3 we aim to understand to what extent a scenario model may be used to detect a time-independent profile for lone-operators. For this experiment, we create ESP PANDORA I that contains detailed information on 157 lone-operator incidents. For RQ4, we aim to understand to what extent data-mining techniques applied to the scenario model may be able to enhance the ability to anticipate criminal behaviour. For this experiment, we create ESP PANDORA II that contains information of 53,289 terrorist incidents.

Chapter 7 Developing the ESP PANDORA

In chapter seven we explain the internal structure of the ESP and the process of data preparation. Eleven sections provide insight into the way data is deconstructed and implemented by 98 variables. Every section includes a detailed table that illustrates the Elementary Scenario Component, its internal structure and its corresponding variables.

Chapter 8 Opening PANDORA's box

Chapter eight aims to answer RQ3. We study how the ESP PANDORA I may be used to detect a time-independent profile for lone-operators. The chapter starts with an outline of the experiment and the process of case-selection. We introduce the four waves of modern terrorism concept of Rapoport (2004), to define the timeframe of modern terrorism and to divide this timeframe into four historic waves. Subsequently, we select 10 incidents of lone-operator terrorism per wave and extract the ESC12 and the corresponding variables from every incident. Next, we analyse the communalities and differences between the different waves of terrorism. In a cross-wave analysis we accumulate the results of every wave of modern terrorism in a search for specific characteristics of lone-operator behaviour. From the results of the experiment, we conclude that a scenario model based on the ESC12 that accumulates different historic criminal incidents, provides an opportunity to analyse historic criminal behaviour in general by transcending the level of individual incidents.

Chapter 9 Discovering PANDORA's box

In chapter nine we address RQ4 by using the ESP PANDORA II that was created in chapter seven and eight. We aim to understand to what extent data-mining tools enhance the ability of the ESC12 scenario model to anticipate criminal behaviour. To this end, we set up a comparative experiment in which we compare the results of two classifiers applied to the ESP PANDORA II: We use (1) the ZeroR classifier (a straightforward classifier that predicts the majority category) to determine a baseline performance as a benchmark for (2) the J48 decision tree (a classifier that builds decision trees using the concept of information entropy). Next, we conduct three experiments that represent three operational law-enforcement situations: (1) the process of investigation of a (terrorist) incident that recently occurred, (2) an active threatening situation in which a strategic location, event, or important person needs to be protected from a possible (terrorist) attack, and (3) the anticipation of future incidents. Based on the accuracy percentages of the tests we conclude that data-mining tools, applied to the ESP PANDORA II do enhance the ability to anticipate criminal behaviour.

Chapter 10 Conclusions

In chapter ten the findings of our study are discussed and generalised to conclusions of the potential of an ESC12 scenario model to anticipate criminal behaviour. By reviewing the answers to the four research questions, we arrive at four conclusions. From these conclusions, we formulate an answer to the problem statement of this thesis. Finally, we suggest five directions for future research.

Chapter 11 Deleted scenes

Chapter eleven is added in accordance with a practice in the film industry in which deleted scenes are made available as a bonus feature during the commercial release of a motion picture. The possibilities of text mining -a subject that did not seem to fit the Ph.D. research-, is believed to offer a valuable addition to this thesis.

As we argued in the previous chapters, there seems to be a strong analogy between a theatrical performance and a terrorist act. This analogy provides us with the opportunity to add *creative narratives* to the ESC12 scenario model. Therefore, we designed an experiment in which we study two hypotheses: (1) *Combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model*. (2) *Text-mining techniques would enable the automatic extraction of the ESC12 variables from works of fiction*. To address the first hypothesis, we investigate the nexus between terroristic and creative narratives by drawing on related scientific studies. To investigate the second hypothesis, we conduct a text mining experiment in which we apply text-mining rules on thirteen novels that were written by Frederick Forsyth. Based on the results of our investigations, we arrive at the conclusion that adding the ESC12 (variables) by means of text mining from works of fiction, would enhance the capabilities of the ESC12 scenario model. Based on this conclusion we build a sneak preview of the future of the ESC12 scenario model.

1.8 Publications related to this research

Parallel to the research described in this thesis, ten other academics have investigated aspects of the ESC12 scenario model[8]. The author of this thesis was co-involved in the guidance of these researches, and was able to employ the results obtained. Below we will list the ten scientific studies that are closely connected to the topic of this thesis.

1. *Prototype Case-based Reasoning – Aanslagen* (Spronck, 2010).
This report decribes a prototype Case-based Reasoning system that was designed to demonstrate the anticipative potential of an anticipative scenario model.

[8] In this thesis the term "ESC12 scenario model" is introduced. Earlier, provisional versions of this model were named "Pandora". Previous researchers who investigated different aspects the provisional scenario model refer to it accordingly. Later in this thesis we will introduce the Experimental Scenario Platform (ESP) PANDORA. To distinguish the provisional scenario model "Pandora" from the ESP PANDORA, we have capitalized the latter.

2. *Individual Terrorism: Indicators of lone operators* (Van der Heide, 2011).
This thesis was published as a result of the Master of International Relations by Utrecht University. Van der Heide investigated to what extent the Pandora model can be used to analyse lone-operator terrorism.

3. *Pandora in de strijd tegen liquidaties* (Schreurs, 2012).
This thesis was published as a result of the Master of Criminal Investigation of the Police Academy / School voor recherche in the Netherlands. Schreurs studied the deployment of the Pandora model in an operational investigation of lethal criminal violence. The thesis was classified as: "Law enforcement use / Secret"

4. *Anticipating terrorism with Pandora II* (Stege, 2012).
The thesis was published as a result of the Master Communication and Information Sciences at the Tilburg University. In this study, Stege investigated the addition of data-mining techniques to Pandora II and the effects that it has on the model's ability to anticipate future behaviour.

5. *Pandora II, Improvements to a scenario model for investigation of terrorist behaviour* (Bressers, 2012).
This thesis was published as a result of the Master Communication and Information Sciences at the Tilburg University. It investigates the possibilities and limits of Pandora II.

6. *Narratieven en Homegrown Jihadistisch terrorisme* (Overheul, 2014).
This thesis was published as a result of the Master of Modern History by Utrecht University. Overheul investigated the value of a narrative model in the field of counterterrorism.

7. *Integrating fictional art into Pandora II* (Von Bannisseht, 2014).
This thesis was published as a result of the Master of Arts in Communication and Information Sciences by Tilburg University. Von Bannisseht investigated to what extent the anticipation of Pandora II would be improved by adding fictional art to the scenario model.

8. *Matching and predicting of incomplete semi-structured textual information* (working title) (De Rydt, 2014). This research is commissioned by ZyLAB Technologies[9], and concludes the Master of Science in Artificial Intelligence by the University of Maastricht. De Rydt investigated how text-mining techniques can be used to extract complex patterns and variables from novels, movie scripts or case files to fill the variables of the ESC12.

9. *Advanced information extraction in text-mining* (working title) (Thimister, 2014). This research is commissioned by ZyLAB Technologies, and concludes the Master of Science in Artificial Intelligence by the University of Maastricht. Thimister investigated how statistics, combined with generally available knowledge, can assist the identification, derivation, and disambiguation of the ESC12 variables from texts.

10. *Visualisation and interactive navigation for search result lists in law enforcement applications* (working title) (Trinnes, 2014). This thesis is commissioned by ZyLAB Technologies, and concludes the Master of Science in Artificial Intelligence by the University of Maastricht. Trinnes investigated in what way a visualisation based on the ESC12, affects the quality of the law enforcement agencies.

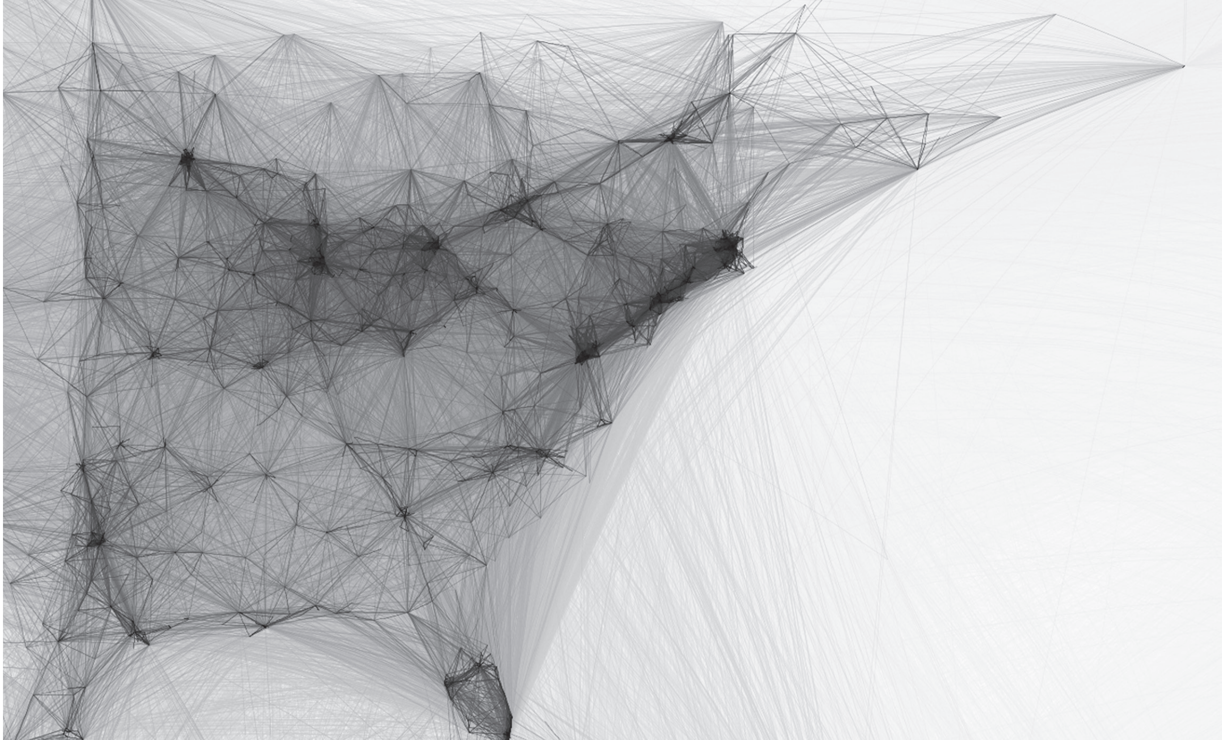
[9] ZyLAB Technologies is a software company that provides software and services to law enforcement and government agencies around the world. ZyLAB's technology is used for analyzing large and complex mult-lingual data collections in criminal, security, intelligence and civil investigations.

What something is depends more on when something is than anything else.
You can't define something accurately until you understand when it is.
Frank Zappa[10]

2

TWO | Understanding Crime

This chapter provides the theoretical framework for our study by focussing on previous research of criminal behaviour.



[10] Frank Zappa (1940 – 1993), American composer, guitarist, and satirist of the 1960s, '70s, and '80s. Zappa was a self-taught composer and performer, and his diverse musical influences led him to create music that was often difficult to categorise.

This chapter forms the theoretical framework for the thesis. It focusses on the overarching theme and provides a deeper understanding of crime in general, and criminal behaviour in particular, by drawing on literature from (a) criminology, (b) terrorism research, and (c) organisational learning.

The chapter commences with an introduction to crime in section 2.1. In this section we provide a definition of *crime* that is used throughout the thesis (definition 2.1). In section 2.2 we present an overview of the three most applicable criminological theories. These theories present a clear and concise insight into the predicaments of criminal behaviour. In section 2.3 we review the organised crime-terrorism nexus, and study the communalities and differences between criminal and terrorist organisations. In this section we provide definitions for *organised crime* (definition 2.2) and *terrorism* (definition 2.3). Section 2.4 is devoted to *lone operators*; a term we will adequately define (definition 2.4). Lone operators commonly referred to as "lone wolves", have a particular set of characteristics that do not seem to fit the regular criminal theories. Yet, they are responsible for criminal behaviour that is significant both in nature and in extent. In section 2.5 we focus on the subject of organisational learning, as this seems to be a decisive factor in the success of criminal organisations. We provide definitions for *learning* (definition 2.5), *adapting* (definition 2.6), *anticipating* (definition 2.7), and *organisational learning* (definition 2.8). Section 2.6 concludes this chapter by a summary of its contents.

2.1 Crime

The words by Frank Zappa at the beginning of this chapter suggest that definitions are prone to change over time. This seems to be particularly true for the definition of *crime*. Crime can be seen as an essentially contested concept. What used to be legal in the past can be considered a crime in the future. For instance, in October 2010 squatting (i.e., the act of occupying an abandoned or unoccupied space without permission of the owner) became a criminal act in the Netherlands. Before that time, squatting was not defined as an unlawful act[11]. This is an illustrative example of how the definition of crime can change over time.

[11] In October 2010 Art. 429sexies Sr. was replaced by Art.138a Sr. By this replacement, squatting became an illegal act in the Netherlands.

Referring to the words by Frank Zappa one could argue that "You can't define something accurately until you understand *where* it is" is equally true. Definitions are limited by time as well as by space. An act that is perfectly legal in one country can be a crime in another. While squatting may be a crime in some countries, in others countries it is merely seen as a civil conflict between the owner and the occupants of a property.

Essentially, what is defined as a crime is constructed by social and political motivations. Because social and political circumstances change, the definition of crime changes accordingly. This axiom is strongly advocated by the American philosopher and criminologist Richard Quinney. In his book *The Social Reality of Crime*, Quinney (2008) proposes a definition of crime, which we adopt in the context of this thesis.

Definition 2.1: Crime

Crime is defined as a definition of human conduct that is created by authorised agents in a politically organised society. (Quinney, 2008)

According to this definition -which itself is based on the concept of definition-, crime is a definition of behaviour that is bestowed on some persons by others. Agents of the law (legislators, police prosecutors, and judges), representing segments of a politically organised society, are responsible for formulating and administering criminal law. Persons and behaviour therefore, become criminal because of the formulation and application of criminal definitions. Therefore, crime is created (Quinney, 2008).

The reason for adopting Quinney's definition in this thesis is that it defines "crime" on a meta-level. It does neither clarify what is regarded as crime, nor does it enforce a moral component. It is a definition about a definition and therefore clearly emphasises the relativity of terms. In the light of this thesis, this is a valuable definition because (a) it embraces terrorism, (b) it transcends the moral component of what is good and what is bad, and (c) it successfully bypasses the essentially contested concept of crime.

However, while Quinney's definition of crime is suitable for understanding crime on a meta-level, it does not explain the nature of criminal behaviour. Therefore, we draw upon the research of criminologists to discover general patterns in the way criminals behave, in the next section.

2.2 Criminological theories

This section aims to provide a deeper understanding of criminal behaviour by building on theories from the field of criminology where sociologists and social anthropologists study the nature, extent, and control of criminal behaviour. Highlighting significant criminological theories will offer insight into the predicaments of crime relevant to the design of a scenario model able to anticipate criminal behaviour.

The motivation behind criminal behaviour is explained by three theoretical approaches: (1) a psychological approach, (2) an economic approach, and (3) a sociological approach (cf. Cote, 2002). Below we briefly summarise these three approaches. In the subsections 2.2.1 to 2.2.3 we discuss a criminal theory from these three theoretical approaches. In subsection 2.2.4 we present a conclusion of this section.

1: The psychological approach

The psychological approach primarily aims at the individual level of the perpetrator. It addresses the question why one person indulges in criminal behaviour while another person does not.

2: The economic approach

The economic approach concentrates on the actual criminal act as opposed to criminality in general. The economic approach argues that criminals -like other individuals- weigh the costs (or risks) against the benefits when deciding whether or not to commit a criminal act. Criminals consequently think in economic terms. According to this perspective, prospective criminals will try to minimise the risks related to an offence by considering time, place, or other situational factors.

3: The sociological approach

The sociological approach considers criminal behaviour from the perspective of the interaction between society and criminality. Following this approach, factors responsible for criminal activities can be found in (a) poverty, (b) communal deterioration, or (c) the dichotomy between what society expects of its citizens and what those citizens can actually achieve.

The three theoretical approaches mentioned above, embrace theories that provide valuable insights into criminal behaviour. To provide an understanding of why people indulge in criminal behaviour, we will select and discuss a criminal theory from every theoretical approach, which we consider to be most appropriate for our research.

2.2.1 The psychological approach: Control theory

Control theory is a theory of motivation that postulates that behaviour is caused by the interest of a person rather than by a response to an outside stimulus (cf. Lissenberg, van Rullen, & Swaaningen, 2001). The control theory avoids addressing the question of *why* some people become criminal, by looking at the reason why some people *do not* become criminal. In doing so, it focusses on the context of a crime (or criminal) to understand criminal behaviour. In the control theory four ways are identified in which people can be committed to society: (1) "attachment to others" (e.g., friends and family), (2) "commitment to achievement" (e.g., work, school, or building a family), (3) "involvement in conventional activities" (e.g., sports, hobby, or communal activities), and (4) "belief in moral validity of rules" (e.g., belief in the biblical principle “Thou shallt not kill”) (Hirschi, 1969). The more a person is attached to one or more of these values, the less the person is prone to become deviant or indulge in criminal behaviour. According to the control theory deviant behaviour occurs where natural commitment to the values of society is compromised (cf. Lissenberg, van Rullen, & Swaaningen, 2001). Essentially, the control theory values the importance of the *context* of a crime.

2.2.2 The economic approach: Rational choice theory

The theory of rational choice belongs to the economic approach (cf. Lissenberg, van Rullen, & Swaaningen, 2001). This theory adopts a utilitarian belief and advances on the idea that the behaviour of every individual (whether criminal or not) is essentially in pursuit of self-interest. Human decision-making is based on finding the most cost-effective way to achieve a specific goal without reflecting on the value of that goal. Whether it is about pleasure, health, wealth or social standing, one decides between the available alternatives and opts for the opportunity that is most cost effective. Costs in this case, are extrinsic to the individual rather than intrinsic (Cornish & Clarke, 1986).

In rational choice theory, criminal behaviour is seen as the result of "free will" of the perpetrator who weighs means and ends, costs and benefits before coming to a rational choice. The theory focusses less on the background of the perpetrator and more on the primary objective for a certain crime. Rational choice theory puts the crime itself at the centre of attention as opposed to criminal behaviour in general. A question that is generally posed and answered from the perspective of this theory is: why does a criminal decide to commit a specific crime? The fact that the perspective of rational choice revolves around the principle of free will established a framework for situational crime prevention strategies: if the perpetrator's primary objective for committing a crime is rational, and based on the aspects of a crime that render it attractive to particular offenders, it seems reasonable to believe that reducing the attractive aspects of a crime can lead to a significant decrease in crime rate (Lissenberg, van Rullen, & Swaaningen, 2001). Essentially, the rational choice theory values the importance of the *primary objective* of a crime.

2.2.3 The sociological approach: Routine activity theory

The routine activity theory (Cohen & Felson, 1979) builds upon the control theory as well as the theory of rational choice and provides a macro-sociological explanation for criminal behaviour (cf. Lissenberg, van Rullen, & Swaaningen, 2001). The routine activity theory explains crime in terms of crime opportunities that occur in everyday life. It argues that a criminal act results from coincidence as well as from the convergence of three requirements:

(1) a motivated offender,

(2) a suitable target or victim,

(3) a lack of capable guardians.

The factor "coincidence" refers to the chance that all three requirements converge in space and time. When the requirements do not unite in a finite location and a finite time, no crime will commence (see Cohen & Felson, 1979). The routine activity theory suggests that stemming the supply of motivated offenders, protecting or removing targets, and providing better guardianship, or at least making sure that these key factors do not coexist in time and place, can be deployed as interventions to help prevent crime.

1: A motivated offender

The first requirement emphasises the driving force of an offender. Although an individual is rarely motivated by a single objective, the motivations for criminal actions fall into three broad categories: Need, Greed, and Power. In the case of terrorism, one could add moral outrage and glory (cf. Borowitz, 2005).

2: A suitable target or victim

A motivated offender goes through a process of target selection. Brantigham and Brantigham (1981) created a model of target selection that identifies areas in which an offender is most likely to commit his or her crimes. The areas of "home", "work" and "shopping and entertainment" constitute comfort zones that allow offenders to commit their crimes under a psychological blanket of protection (cf. Holmes & Holmes, 2009). This model obviously applies to offenders that exhibit some sort of spatial decision-making process. But every criminal that engages in target selection, contemplates the opportunities of a prospective location; assessing its accessibility, possible escape routes as well as the risk of apprehension (see Holmes & Holmes, 2009).

3: A Lack of capable guardians

The third requirement in the routine activity theory is the level of resistance. When a motivated offender identifies a suitable target, the level of resistance or "lack of capable guardians" becomes a determining factor in the process of committing a crime. A target with a capable guardian is less likely to be compromised by a potential offender than a target without a guardian. If the level of resistance appears weak, corrupt, or relatively incapable, little protection for the target is provided (see Boetig, 2006).

Law-enforcement officers and security guards represent formal guardians. Neighbours, friends, or (unwitting) citizens, represent informal guardians. Capable guardians do not necessarily have to be people; close circuit television, burglar alarms, or animals can function as guardians as well, although their capability may vary (see Boetig, 2006).

Essentially, the routine activity theory values the importance of *motivation*, *target*, and *resistance* of a crime.

2.2.4 Section conclusion

The aforementioned approaches and corresponding criminal theories offer valuable insights into the predicaments of crime and criminal behaviour. The theories emphasise the importance of components such as *context* (Control theory), *primary objective* (Rational choice theory), *motivation*, *target*, and *resistance* (Routine activity theory), and the interdependent connection between them. It is clear that the design of a scenario model able to anticipate criminal behaviour can benefit from these insights, and should value these components of criminal behaviour. To distinguish criminal behaviour in general from terrorist behaviour, we will explore the crime-terrorism nexus in the next section.

2.3 The crime – terrorism nexus

The crime - terrorism nexus is an intriguing connection that we illustrate by the example provided in box 2.

Box 2: The Columbian[12] illustration

October 2006: On a muddy field in the jungle of Colombia, an official of the *Ejército Nacional de Colombia* (National Army of Colombia) showed some of the explosive charges he and his men seized from the FARC (*Fuerzas Armadas Revolucionarias de Colombia*) in the mountains around Medellin[13]. One of the improvised explosive devices (IED) put on display was a small plastic box. The device was found when members of the Anti-Narcotics Brigade raided a cocaine laboratory. It was meant to detonate upon entry of a person who did not activate the safety catch. The explosive did not discharge however, so the army had dismantled it and put it on display for educational purposes[14]. Obviously, the box was self-made. It contained about half a kilogram of explosives, some electronics, a safety catch and a compartment for AA-type batteries. On the inside of the battery compartment, a small piece of paper was taped. The paper stated in plain English "Use Duracell only".

The discovery of the IED by the *Ejército Nacional de Colombia* is a small and scientifically insignificant incident but it illustrates beautifully some key elements of this chapter. For that reason it will be referred to several times throughout this chapter. First, it will be used to define *organised crime* (in subsection 2.3.1) and *terrorism* (in subsection 2.3.2). As the communalities and differences between crime and terrorism will prove to be essential in the structure of this thesis, we will refer to the Columbian[9] illustration again in subsection 2.3.3 where we will explore the nexus between the two terms. We refer to box 2 in section 2.6, where it will serve as an illustration to be referred to in studying *organisational learning*.

[12] The ethnic modifier "Columbian" is used here to refer to the example described in box 2. We are by no means implying that criminal behaviour can be understood by considering race, ethnicity, or national origin.

[13] As a documentary film director covering stories in conflict areas and war zones around the world, the author of this thesis was one of the delegates present.

[14] It should be noted here, that the claim that the device was put there by the FARC may be questioned. After all many organisations operate in the drug trafficking markets of Colombia, and the Colombian Army at the time was at war with leftist rebels of not only the FARC, but also FARC-EP (*Ejército del Pueblo*), with ELN (*Ejército de Liberación Nacional*), and EPL (*Ejército Popular de Liberación*), as well as with right-wing paramilitary groups. All of these organisations have a history in trafficking cocaine as well as in the use of explosives.

2.3.1 Organised crime

According to the army official who presented the IED, the English words "Use Duracell only" in the explosive box can be seen as a manual, a how-to guide, suggesting that the device was made by one person, to be used by another. Possibly, it even suggests that the piece of equipment was made outside of Colombia and, in effect, may be evidence of the ties between criminal organisations in Colombia and countries in which Spanish is not generally spoken. Whatever way it is seen, the note is a feasible indication that more than one person was engaged in the engineering and placing of the IED and therefore some form of organisation was involved, be it criminal or terroristic.

"Organised crime" is a term that is generally used quite loosely and proves to be hard to define. Von Lampe (n.d.) collected over 150 different definitions of organised crime and comments on the problem of how to distinguish organised crime from various types of sources[15] (von Lampe, n.d.). Some definitions are based on the structure of the organisation, others on their goals. Some definitions refer to the (international) connections with (criminal) organisations or people, others to the techniques that are supposedly used (such as violence, intimidation, and corruption). Although it is hard to classify or to find a consensus among the different descriptions, it can be said that the majority of definitions value "the cooperation between (groups of) people" as an essential factor in the term "criminal organisation" (cf. von Lampe, n.d.).

For the purposes of this thesis, we adopt the definition of organised crime as defined by Chibelushi, Sharp, and Shah (2006). Our choice is motivated by the fact that this definition includes religiously and politically motivated crime as well as terrorism.

Definition 2.2: Organised crime

Organised crime is defined as a group of two or more people existing for a period of time and acting in concert with the aim of committing one or more serious crimes that are motivated by politics, religion, race, or financial gain. Organised crime can include terrorism, drug trafficking, fraud, gang robberies, and other group-oriented criminal activities

(Chibelushi, Sharp, & Shah, 2006)

[15] See www.organized-crime.de/OCDEF1.htm.

Chibelushi, Sharp and Shah (2006) define organised crime by describing what organised crime does, as well as by introducing the motivation of organised crime. We adopt their proposition because Chibelushi, Sharp and Shah explicitly state that "organised crime can include terrorism, drug trafficking, fraud, gang robberies, and other group-oriented criminal activities". This is a valuable addition in relation to our thesis in which we will study a scenario model able to anticipate criminal behaviour, by developing an Experimental Scenario Platform in the narrow field of terrorism.

Having defined organised crime, we will delineate the term terrorism in the next subsection. Subsequently, in subsection 2.3.3 we will focus on the relation between criminal and terrorist organisations in detail.

2.3.2 Terrorism

According to Alex Schmid, an internationally renowned scholar in the field of terrorism studies, there is neither an academic nor a legal consensus regarding the proper definition of the word "terrorism". Having studied more than one hundred definitions of terrorism, Schmid concludes that definitions generally tend to reflect the political interest and the moral judgement of those responsible for defining (Schmid, 2004).

Although there might not be a consensus regarding the proper definition of the word "terrorism", several international organisations related to (the research of) counter terrorism created definitions to suit their specific needs.

In *Individual Terrorism: Indicators of lone operators*, Van der Heide (2011) compares (a) the definition of terrorism used by the US state department, (b) the definition of the European Union, (c) the definition used under Dutch Law, and (d) the definition of the Global Terrorism Database with (e) a definition proposed by Schmid and Jongman (1988). Van der Heide concludes her comparison by stating that while certain broad elements of terrorism are generally agreed upon (i.e., the intentional use of violence), many other factors (such as whether victims of terrorism must be (non)combatants; whether terrorism requires a political motive; whether states can be terrorist actors) continue to be debated. The biggest common denominator in the definitions of terrorism is the (intentional) use of violence combined with a political motivation (cf. Van der Heide, 2011).

In her master thesis, Van der Heide concludes that the definition proposed by Schmid and Jongman (1988) provides a strong academic base and in addition follows what Van der Heide calls a "double victimisation principle". This principle, which we will explain below, is of great value in the context of this thesis.

In addition to the definition of crime given in section 2.1 (and that of organised crime in subsection 2.3.1), we will define terrorism as follows.

Definition 2.3: Terrorism

Terrorism is an anxiety-inspiring method of repeated violent action, employed by (semi)clandestine individual, group or state actors, for idiosyncratic, criminal or political reasons, whereby - in contrast to assassination - the direct targets of violence are not the main targets.

(Schmid & Jongman, 1988)

What distinguishes the definition by Schmid and Jongman (1988) from other definitions studied by Van der Heide, is the two different types of targets that are explicitly discriminated in the definition: (i) a "direct target" and (ii) a "main target". This is called "principle of double victimisation" (Van der Heide, 2011). It refers to the concept that the direct target of the attack is distinguishingly different from the main target.

The scope of this implication can be best explained by regarding a terrorist act as a mode of communication. Establishing a relation between terrorism and communication is not a new approach; it has been the subject of several studies since the 1980s (Decker & Rainey, 1980; Schmid & De Graaf, 1982; Schmid & Jongman, 1988; Weiman & Winn, 1994; Crelinsten, 2002; Weimann, 2008; De Graaf, 2011). While approaching the subject from different perspectives, all of these studies agree that terrorism is strongly related to the distribution of a message. Moreover, Schmid and De Graaf (1982) explicitly state that terrorism <u>is</u> communication.

Terrorism as a form of communication

The fundamental nature of communication is included in the "linear model of communication" (Shannon & Weaver, 1949). According to this model, successful communication requires a *sender*, a *message*, and an -intended- *recipient*. Figure 2.1 depicts the linear model of communication. The ellipses symbolise the communication environment and illustrate where the message is encoded or decoded. Where the ellipses overlap, the communicating parties need to share an area of communicative commonality. This is the crux of effective communication.

Not depicted in figure 2.1 is "noise", the general interference of effective transmission and reception of a message. Noise can be physical (environmental distractions), physiological (preconception bias), or semantic (confusing use of language), and can occur throughout the communication process.

The overall goal of the sender is to communicate. The process of communication is completed once the receiver has understood the sender.

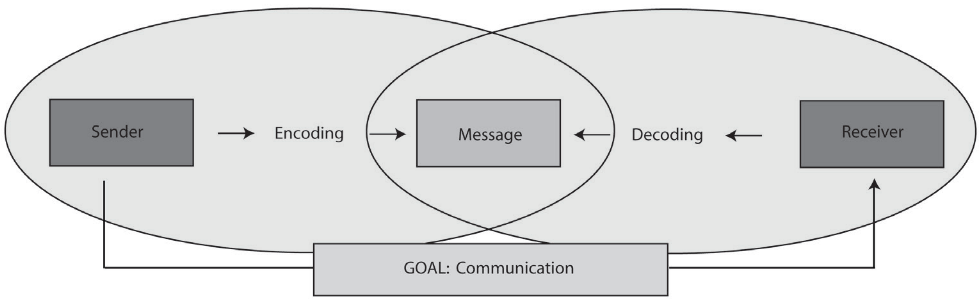


Figure 2.1 The linear model of communication.

When the linear model of communication is applied to a terrorist act, the terrorist (organisation) responsible for the violent act represents the *sender* of the message (see figure 2.2). The goal in "communication" for a terrorist act is to achieve influence, retaliation, intimidation, coercion or propaganda (see Schmid & Jongman, 1988).

The *recipient* is represented by what Schmid and Jongman describe as "the main target"; it is the entity to whom the message is addressed. In a terrorist act, this will effectively be the entity whose behaviour the sender of the message wants to influence.

By disconnecting the "direct target" from the "main target" of a terrorist attack, Schmid and Jongman (1988) recognise the role of *symbolism* in a terrorist context. In other words, the direct target for a terrorist attack is selected for the symbolic relation it holds with the main target and/or with the goal of the terrorist (organisation). The person, group of people, or location that is targeted (i.e., direct target), can be seen as "message generators" or described as "the skin of a drum beaten to achieve a calculated impact on a wider audience" (see Schmid & de Graaf, 1982). According to Schmid and Jongman, this direct target of violence can be chosen randomly or selectively from a target population. Whatever way it is selected, the direct target carries the *message* and effectively is selected for its symbolic value.

The role of the audience

Schmid and Jongman (1988) include "an audience" in the main target group. However, we would prefer to exclude the audience from that group. An audience, in our view, is a fourth entity (viz. Terrorist organisation, Direct target, Main Target, and Audience), which also –and separately from the main target- interprets the message. When the role of the audience is regarded as a fourth entity and introduced in the linear model of communication, a new model emerges as is depicted in figure 2.2.

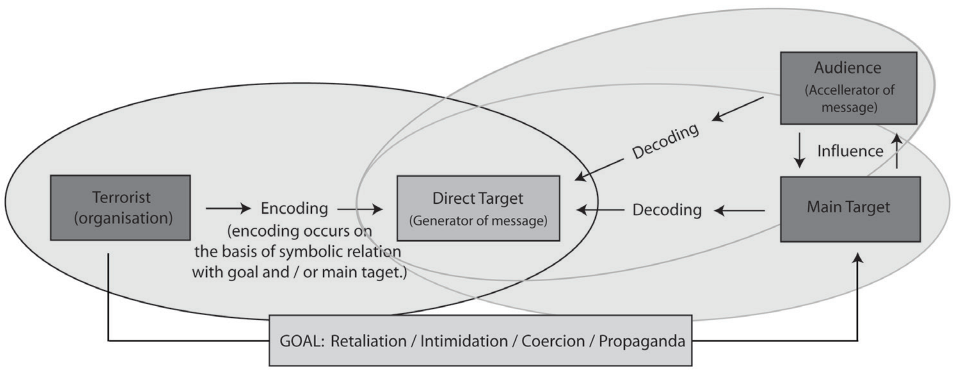


Figure 2.2 Terrorism as form of communication.

If the audience is seen as a separate entity, with an autonomous role (and a separate communicative environment –as represented by the ellipse-) it may be utilised to influence the main target. For terrorists, an audience can have an influential role in translating and disseminating the message. Concurrent with describing the main target as "message generator", we argue that the role of the audience can be seen as a "message accelerator" (or "message decelerator", for negative acceleration is deceleration).

In counter-terrorism strategies, the role of the audience can offer possibilities for manipulation into a "message decelerator". An example of this is given by terrorism researcher De Graaf (2011). In media coverage, she argues, the role of Al Qaeda is frequently enhanced because different kinds of successful terrorist acts are attributed to Al Qaeda. For an audience, this creates the image of a large and ubiquitous organisation. This enhancement effectively accommodates the ambition of Al Qaeda and provides them with the public theatre they strive for. However, guiding an audience in the direction of thought that Al Qaeda is a collection of loosely coupled small cells and random individuals with little coherent guidance, is equally true and creates a completely different picture of the organisation (De Graaf, 2011).

We conclude this section by noting that literature suggest that in the violence-based communication process between the *sender* (the terrorist (organisation)), and the *recipient* (the main target that the sender wants to manipulate), the *message* is attached to, and sent via, the direct target. By recognising that terrorists are primarily focussed on (a reaction of) another target than their direct victims, Schmid and Jongman (1988) include an essential and discriminative element of terrorism in their definition. While this allows for easy classification of organised crime and terrorism in real world situations, the discrimination might not be as clear, as we will illustrate in subsection 2.3.3.

2.3.3 Crime and terrorism

As the Colombian[16] example in box 2 demonstrates, organised crime and terrorism have a significant overlap. Planting an explosive device to protect intruders entering a cocaine plantation is a criminal act. Its purpose has little, if anything, to do with what is widely regarded as terrorism. It has to do with protecting assets or interest, or perhaps with destroying contraband or evidence. Yet, the FARC (as well as the other criminal organisations mentioned in footnote fourteen) are

[16] See footnote 12.

regarded as a terrorist organisation by most governments[17]. This close link between crime and terrorism brought forth the term "Narco-terrorism", a word that is generally used to describe both the tactics of drug trafficking organisations as well as the means of funding for terrorist organisations. The intricacy of crime and terrorism and the nexus between them is illustrated in *Crime and Terrorism* (Grabosky & Stohl, 2010) where apparent examples are given of (1) terrorist organisations that engage in crime, (2) terrorist organisations that become criminal organisations, (3) terrorist organisations that are teaching criminal organisations, and (4) terrorist organisations that effectively are criminal organisations. While the focus of our discussion is primarily directed at terrorist organisations shifting towards organised crime, it has to be noted that the crime – terrorism nexus is recursive. In other words, the transition from organised crime towards terrorism is equally apparent. Below, we briefly describe the four examples of the crime – terrorism nexus.

1: Terrorist organisations engage in crime

Terrorists may engage in criminal behaviour to support themselves or their operations. For instance, Al Qaeda has engaged in credit-card fraud to generate revenues for their operations. Vice versa, criminal organisations may want to intimidate governments or citizens for political reasons. For instance, the assassination of Giovanni Falcone in 1992 was meant as political statement made by the Italian mafia to discourage further investigations.

2: Terrorist organisations become criminal organisations

Terrorists may abandon their ideology and turn to conventional criminals. A phenomenon described accurately by Grabosky & Stohl (2010) by the expression "Fighters turn fellons". Vice versa, ordinary criminals may become increasingly politicised and convert to terrorism as was the case with Mohammed Bouyeri, the assassin of the Dutch Filmmaker Theo van Gogh, who started his criminal career as a petty thief before he turned to ideological criminal violence (Buruma, 2007).

[17] FARC are a violent non-state actor (VNSA), described as a terrorist organisation by (amongst others) the Colombian government, the US department of state, the Canadian government, the New Zealand government, and the European Union. The Venezuelan government is one of the governments less hostile towards the FARC. In January 2008 Venezuelan president Hugo Chávez publicly rejected the classification of the FARC as "terrorists", considering them to be "real armies".

3: Terrorist organisations teach criminal organisations

The exchanging of knowledge between criminal and terrorist organisations is a different "marriage of convenience" (Mincheva & Gurr, 2010). Extensive research over the last decade brought to light many examples of knowledge distribution, the relation between the FARC and drug cartels in Colombia being one of them.

4: Terrorist organisations are criminal organisations

Hybrid organisations that engage in both terrorist and criminal activity have arisen too. For instance, the Indian organised crime syndicate D-company is allegedly involved in drug trafficking, money laundering, as well as a bombing in Mumbai that killed 257 people in 1993 (Grabosky & Stohl, 2010).

As the aforementioned illustrations suggest, crime and terrorism can have a significant overlap, and may be hard to distinguish.

Having elaborated on the communalities and differences between organised crime and terrorism, we will advance to a common denominator of the two: the ability to learn (cf. Jackson, 2005). However, before we do so we need to draw attention to a phenomenon that is apparent in crime as well as terrorism: individuals that are able to learn, yet work outside an organisation: the lone operators.

2.4 Lone operators

The reason for adding a separate section on lone operators lies in the fact that lone operators represent a special category of perpetrators with characteristics that are distinctly different from individuals operating in criminal or terrorist organisations. Still they represent a threat that is considered "more terrifying and volatile than their terrorist forbears" (Sageman, 2008). Moreover, the third research question of this thesis reads: *To what extent can a scenario model be used to analyse historic criminal behaviour?* To answer this research question, we will use an experimental scenario platform to assess to what extent a time-independent profile of lone-operator terrorism can be detected by analysing data of historic incidents contributed to the actions performed by lone-operator terrorists.

A classification of terrorists is provided by Frederic Hacker (1976). On a personal and personality level, Hacker classifies three types of terrorists: *criminals*, *crazies*, and *crusaders*. "While criminals engage in terrorist activity for personal gain like a financial goal or vengeance, crusaders are oriented towards power and prestige in relation to a group ideology. Crazies, are simply emotionally disturbed individuals" (Hacker, 1976).

As terrorism is usually viewed as a collective activity (COT, 2007), Hacker's classification of terrorists has been used to explain the motive of individual terrorists within a terrorist organisation. However, over the course of the last years the threat of an individual terrorist action has reasserted the perceived threat of a terrorist who operates outside a network (COT, 2007). When *criminals*, *crazies*, or *crusaders* operate on an individual level, they represent a completely different category of terrorists; they become lone-operator terrorists.

There are numerous ways in which lone-operator terrorism is described, and they are all context specific: lone-wolf terrorism, anarchism, revolutionary terrorism, individual terrorism, vanguard movements, leaderless resistance, guerrilla warfare, and phantom cell structures, being among them (cf. Van der Heide, 2011). In *Individual Terrorism: Indicators of lone operators,* Van der Heide (2011) studies the history of individual terror and compares different definitions of lone-operator terrorism. In her conclusion, Van der Heide proposes the term "lone operators", a proposition which we will adopt in this thesis.

Definition 2.4: Lone operators

Lone operators are individuals who are not part of a larger network but who solely decide, plan, and perform their act, inspired rather than instructed.
(Van der Heide, 2011)

The definition by Van der Heide is applicable in the light of this thesis for two reasons.

1. The definition of a lone operator embraces the traditional individual acting solely on his own initiative and in addition includes the smallest networks (such as two persons, autonomous cells, and leaderless jihadism).

2. The definition proposed by Van der Heide is not inextricably coupled with terrorism. Disconnecting "operators" from "terrorism" opens a valuable avenue, making both definitions more operational in the broader field of crime.

An illustration of the last argument can be found in the case of Ricardo López. In 1996, López, an obsessed fan of Icelandic singer songwriter Björk, mailed her a parcel filled with acid which was meant to explode upon opening defacing or killing her. While this incident matches the criteria of "lone operator" as proposed by Van der Heide, it is generally not regarded a terrorist action. Classifying López as a "lone operator" and disconnecting this definition from terrorism, opens the possibility of comparing López' Modus operandi to that of other lone operators, for example, that of the Austrian Franz Fuchs, who used letter bombs to kill 4 and injure 15 people.

Detection of lone operators

Lone operators by nature function individually, disconnected from any chain of command. Although "leakage"[18] may occur, they generally do not communicate with others with regards to their intentions (Bakker & De Graaf, 2010). This gives them two critical strategic advantages over organisations in escaping detection: (1) lone operators do not communicate to other operatives and (2) lone-operator behaviour resembles the behaviour of troubled people. Below, we briefly discuss both reasons why lone operators are hard to detect.

1: Lack of communication to other operatives

Counter-terrorism and law-enforcement organisations rely heavily on intelligence. Operators that work outside a network or chain of command and do so without any form of communication, are hard to identify, and even much less to monitor. In *The challenge of the lone wolf*, Fred Burton (2007) argues that if militants operate in a cell consisting of more than one person, there is a chance that (a) one of them will get cold feet and reveal the plot to authorities, (b) that law-enforcement personnel will intercept a communication, or (c) that law-enforcement authorities will be able to introduce an informant into the group.

[18] Leakage in this context refers to any form of (un)intentional communication of intentions.

2: Lone-operator behaviour resembles behaviour of troubled people

The second important reason that lone operators are hard to detect is the fact that they portray social behaviour which is similar to that of people who are alienated from, or angry or frustrated with, society. This makes it rather hard to discern potential lone-operator attackers from troubled people. "With such a large population of suspects, finding a lone-operator terrorist is like finding a needle in a haystack" (Burton, 2007).

Effectiveness of lone operators

While lone operators lack the manpower, means, and *organisational learning* (see definition 2.8) that an organisation has, they do not necessarily have to be less efficient. A lone operator can easily acquire information from manuals, recipes, tactics, or instructional videos that are readily available. For instance, the manifesto of Breivik has circulated on the Internet since days before he detonated a bomb in the centre of Oslo and started his killing spree on the island of Utoya. Also, the manifesto of "The Unabomber" Ted Kazcynski, or the letters by Mohammed B who assassinated the Dutch filmmaker Van Gogh, can easily be aquired.

Because of their hard-to-detect nature, lone operators have proved to be so effective in their actions, that it is stimulated as a tactic by terrorist organisations. For instance, shortly after the death of Osama Bin Laden the website Ansar al-Mujahideen posted a video message by Al Qaeda's chief spokesman, calling for local jihadists or "lone wolfs" in the United States to take up arms against Americans (cf. Van der Heide, 2011).

Prevention of lone-operator attacks

In 2010, an expert meeting called "Lone wolves" was organised by the International Centre for Counter-terrorism in The Hague, in which the notion was postulated that sharing experiences, data, and ideas between practitioners, policy makers, and academics is the key to understanding and preventing the phenomenon of lone-operator terrorism (cf. Bakker & De Graaf, 2010). Shone (2010) draws a similar conclusion in his essay *Countering lone-wolf terrorism*. He proposes that an effective counter-terrorism approach should be based on the capture and sharing of effective data and the exploitation of that data by efficient overall information management and fused intelligence products (Shone, 2010).

Having elaborated on the subject of lone operators, a phenomenon that is apparent in crime as well as terrorism, we advance on organisational learning in the next section.

2.5 Organisational learning

An important common denominator of terrorist and criminal groups is their ability to learn; to disseminate knowledge within their organisation. "Learning is the link between what a group wants to do and its ability to gather the needed information and resources to actually do it" (Jackson, 2005). As organisational learning will prove to be an essential element in this thesis, this section provides insight into its mechanisms. In subsection 2.5.1 we will study the critical elements responsible for failure in military campaigns, and in subsection 2.5.2 we will relate these terms to the organisational learning of a terrorist organisation. In subsection 2.5.3 we will describe the value of organisational learning in anticipating criminal behaviour.

2.5.1 Learn, adapt, and anticipate

The critical elements that befall competent military organisations are identified by the study *Military Misfortunes: The Anatomy of Failure in War* (Cohen & Gooch, 1985). The study investigates the failure of military strategies, a phenomenon that translates easily from the military world to the world of law enforcement and especially to that of counter-terrorism. To quote Cohen and Gooch: "Everyone in uniform lives with what has perceptively been called 'the knowable possibility of disaster'."

To identify the critical elements responsible for the disaster of a military intervention, Cohen and Gooch selected five military campaigns in which, in terms of equipment and means, a relative equality existed between the opposing forces. In their study, three basic kinds of failures were identified: the failure to learn, the failure to adapt, and the failure to anticipate. As these failures hold valuable lessons in the design of a scenario model designed to anticipate future behaviour, we will define the critical elements learning, adapting, and anticipating as follows.

Definition 2.5: learning
Learning is the ability to absorb readily accessible lessons from history.

Definition 2.6: adapting

Adapting is the ability to take appropriate action to deal with new and unexpected situations.

Definition 2.7: anticipating

Anticipating is the ability to make decisions concerning future events in a timely and effective fashion, based on the interpretation of past events[19].

As Cohen and Gooch (1985) argue, single failures to learn, to adapt, or to anticipate, occur in organisations and military campaigns on a regular basis. They are part of organisational life. The resilience of a healthy organisation usually offers sufficient pliability to turn a single one of the aforementioned failures into a (major) setback. However, when two failures coincide, an "aggregate failure" occurs: a situation that, even for a healthy organisation, is hard to overcome.

When an organisation experiences all three failures simultaneously or consecutively, there is often no escape from absolute disaster. Such a compound failure carries with it the risk of bringing about a total defeat or political collapse of an organisation. Only outside forces coming to the aid of the sufferer can offer a dim chance of escape. However, in the cases studied by Cohen and Gooch only catastrophe resulted.

We note that the ability to learn, adapt, and anticipate, represent past, present, and future. Where the failure to learn has its roots in the past, the failure to adapt suggests the incapacity to handle present changes. The failure to anticipate finally, represents the inability to look into the future.

Mapping the learning curve of an organisation, and using this information either (a) to learn, (b) to adapt tactics in order to prepare for unforeseen challenges, or (c) to anticipate their next move, seems (based on the literature described above) a viable way of anticipation. Consequently, for a scenario model designed to anticipate future behaviour, the ability to learn, adapt, and anticipate, may provide important building blocks.

[19] Notably, the definition of "anticipating" is brought in relation with definition 1.1 of this thesis; the definition of "anticipation".

2.5.2 Accumulation, articulation, and codification

To address the subject of accumulation, articulation, and codification, we refer to the illustration provided in box 2, in which the discovery of the "Use Duracell only" note inside the improvised explosive device, suggests (one of) two implications.

First, it suggests a heuristic method of obtaining knowledge. The army official who presented the explosive, suggested a trial-and-error way of obtaining knowledge and argued that the note was put there because in the past a similar IED failed to work for a specific reason: The errand boy who had been given money to buy batteries for the IED, saw himself confronted with a dilemma; to spend the money on expensive batteries or on a pack of cigarettes and cheaper batteries. His decision indirectly avoided human casualties because the device did not detonate when it was supposed to. The "Use Duracell only" note was supposedly attached to the IED to warn future users for inferior quality batteries.

Secondly, the paper glued to the inside of the improvised explosive device may be seen as a way of distributing knowledge between people or cells. According to the army official the English note suggested the explosive was purchased from a criminal organisation outside of Colombia that traded knowledge, arms, and training with the FARC[20]. This specific explosive failed to detonate, as he argued, because the note was written in English, while the guerrilla's responsible for placing the explosives could only read Spanish.

Essentially, the English note may be seen as a user manual attached by a sender who intended to communicate a message to the receiver (see figure 2.1 The linear model of communication[21]). It distributes experience gained in the past to prevent mistakes in the future. This is a form of evidence of which Zollo and Winter (2002) describe as "learning mechanisms"; the combination of tacit accumulation of past experience, knowledge articulation, and knowledge codification. Based on Zollo and Winter (2010) we provide our definition of organisational learning below.

[20] See footnote 14.

[21] We note that the fact that the message was written in English, and found in a country in which English is not generally spoken, might suggest that the sender and the receiver did not share an area of communicative communality (see figure 2.1)

Definition 2.8: Organisational learning

Organisational learning develops through the coevolution of three mechanisms: tacit accumulation of past experience, knowledge articulation, and knowledge codification.

The three mechanisms upon which our definition of organisational learning is based, viz. (1) tacit accumulation of past experience, (2) knowledge articulation, and (3) knowledge codification, are explained below.

1: Tacit accumulation of past experience

Tacit accumulation of past experience refers to experiential wisdom; the outcome of trial and error and the selection and retention of past behaviours (Gavetti & Levinthal, 2000). The fact that the explosive device described in the introduction of this section did not function in the past, and the assessment that this could be traced back to inferior batteries (whether this observation is correct or not) can be seen as the tacit (or implicit) accumulation of past experience.

We note that while some types of knowledge lend themselves to articulation (and codification), intuitive skills resist simplification into formal systems. Ingenuity, elusiveness, deceit, and manipulation techniques are among the skills that are hard to articulate and even harder to codify (cf. Kenny, 2007).

2: Knowledge articulation

Knowledge articulation is the process through which implicit knowledge is articulated. In organisations this occurs through collective discussions, debriefing sessions, and performance evaluation processes. It happens when individuals express their opinions and beliefs, engage in constructive confrontations, and challenge each other's viewpoints (cf. Zollo and Winter, 2002). The knowledge articulation in the example described in box 2, lies in a process that led to the formulated opinion that future mishaps could be prevented by the warning not to use an inferior type of batteries.

3: Knowledge codification

Knowledge codification is a step beyond knowledge articulation. Knowledge codification happens when individuals codify their experience in written tools, such as manuals, blueprints, spreadsheets, decision support systems, project management software. (cf. Zollo & Winter, 2002). Consequently, the fact that a note was attached to the explosive device can be regarded as codification of knowledge.

2.5.3 Organisational learning and anticipating criminal behaviour

The organisational learning of an organisation can offer valuable avenues of anticipating criminal behaviour. In *The age of the unthinkable*, Ramo (2009) exposes a direct link between the organisational learning of a criminal organisation and the way to anticipate their behaviour, when he quotes Aharon Farkash, former head of the Israeli Military Intelligence Directorate (MID).

Farkash distinguishes two levels in terrorist organisations. The first is the surface level that is in charge of daily activities, such as funding, the recruiting of new members, and obtaining weaponry. The second, a deeper level of a terrorist organisation, is the level responsible for the resilient capabilities, i.e., the level where innovation and change is orchestrated. Although an organisation can have hundreds of members, only a few people facilitate organisational learning. Farkash named this the "innovational node" of the organisation, and he made a tactical decision to focus the attention of the MID to the elimination of this node. Farkash (as stated by Ramo (2009)): "The tactic, once it had been perfected seemed to have astonishingly effective results. The groups were unable to grow and change. Terror attacks plummeted".

The organisational learning of criminal groups has been the centre of focus of a growing number of studies. In *Aptitude for Destruction: Organisational learning in terrorist organisations and its implications for combating terrorism* (Jackson, 2005), the importance of understanding the process of organisational learning of a specific group is studied. "Continuing conflicts between violent groups and states generate an ever-present demand for higher quality and more timely information to support operations to combat terrorism. In particular, better ways are needed to understand how terrorist and insurgent groups adapt over time into more effective organisations and increasingly dangerous threats. To adapt, terrorist organisations must learn. A group's ability to learn determines its chance of success, since learning is the link between what the group wants to do and its ability to gather the need of information and resources to actually do it. (…) While relevant data and insights can be found in the literature on terrorism, and terrorist organisations, this information has not been collected and systematically analysed to assess its importance from the perspective of efforts to combat terrorism." (Jackson, 2005).

Jackson concludes his study by stating that investigating the way terrorist organisations learn can be a valuable addition to the intelligence and law-enforcement "tool box". One of the key findings of the study reads: "Apply models of terrorist organisations' learning behaviours to the design of novel countermeasures that specifically target their ability to adapt and change." (Jackson, 2005).

By this conclusion Jackson explicitly underlines the importance of countermeasures that can be designed on the basis of modelled data. In addition, he concludes that targeting a terrorist organisation's ability to change can be a valuable addition to law enforcement.

2.6 Chapter summary

This chapter provided an overview of the predicaments of criminal behaviour by drawing on international studies. First, we defined *crime* and provided a general background on crime and criminal behaviour. Next, we examined theories from criminology to ascertain essential components of crime, and studied the interdependent connection between them. Based on these criminal theories, we found that criminals try to find the most cost-effective way to achieve a specific goal and that the motivation of an offender, as well as the availability and accessibility of a target are relevant in understanding criminal behaviour. Moreover, we ascertained essential components of criminal behaviour such as *context*, *primary objective*, *motivation*, *target*, and *resistance* that might prove valuable in the design of a scenario model, able to anticipate criminal behaviour.

Subsequently, we defined *organised crime* and *terrorism* and studied the communalities and differences between them. We argued that although the definitions between crime and terrorism are clearly distinct, criminal and terrorist organisations show several forms of overlap.

Focussing on terrorism, we explained the principle of double victimisation and proposed another look at the role of the audience in terrorist incidents. We argued that by distinguishing the direct target of a terrorist act from the audience that is targeted, the role of *symbolism* in a terroristic attack may be recognised and valued.

“Lone operators” represent a special category of criminals that do not blend in well with criminal or terrorist organisations. We therefore proposed a suitable definition and determined the specific characteristics of *lone operators* in relation to criminal behaviour.

A common denominator of terrorist and criminal groups is their ability to disseminate knowledge within their organisation. We defined organisational learning and, building on research that investigated the failure of military strategies, we defined three critical success factors: *learn*, *adapt*, and *anticipate*. We subsequently related these factors to organisational learning and criminal organisations. Finally, we focussed on the possibilities that organisational learning can offer in anticipating criminal behaviour.

In summary, we gathered knowledge of the specific characteristics responsible for criminal behaviour in general, and those of terrorist behaviour in particular. With this knowledge, that sets the theoretical basis of the thesis, we will advance to chapter three in which we will investigate scenario planning as a means of anticipating criminal behaviour.

3

THREE | Using scenarios

That which hath been is that which shall be,
and that which hath been done is that which shall be done;
and there is nothing new under the sun.

Ecclesiastes[22]

This chapter will focus on the use of scenarios in the anticipation of future events, and will answer the first research question of this thesis.

[22] The book of Ecclesiastes (3rd century BC) is an Old Testament book of wisdom literature that belongs to the third section of the biblical canon, known as the Ketuvim.

In this chapter we will address the first research question of this thesis: *What does literature on scenario-based anticipation methods offer that is relevant for the development of a scenario model by which criminal behaviour can be anticipated?* To this end we will review the existing literature, and consider the critical points of current knowledge on scenario-based anticipation methods. We will try to identify, appraise, select, and synthesize high-quality research evidence relevant to the subject of our thesis.

As Ecclesiastes' words suggest, men have been trying to anticipate future incidents from the beginning of recorded history. Cyclical events such as the day and night cycle, the monthly fertility cycle, seasonal cycle, and even the biological cycle of life and death suggest that some sort of forecasting seems feasible. Cycles only need to be identified, in order to forecast future events (List, 2005).

Forecasts are made on the basis of a collection of values observed sequentially through time. Extrapolation of that collection creates a tangent line at the end of the known data and extends it beyond. By its nature, forecasting will only provide good results when used to extend the graph of an approximately linear function or not too far beyond the data that is known (Gibilisco, 2004). For instance, population growth may only be forecasted adequately for a certain area and for a certain timeframe.

However, what makes forecasts dangerous is that their strength is also their weakness; they are based on cyclicity. In other words, forecasts are frequently constructed on the assumption that tomorrow's world will be much the same as today's. Consequently, forecasts fail when they are needed the most, namely when major changes suddenly occur (Kenter, 1998). When the variables alter, even the most sophisticated forecasting techniques proved to be significantly inaccurate (Armstrong, 2001).

The latter type of conclusions led to the search for new and innovative techniques to address the uncertainties of the future. It formed the basis of what was about to become the most widely utilised anticipatory technique: "scenario planning".

Scenario planning is designed to anticipate the type of uncertainties that also have to be addressed in anticipating criminal behaviour. Therefore the aim of this chapter is to identify the value of scenarios in the design of a new model able to anticipate criminal behaviour. We will do so by (a) reviewing the literature on the use of scenarios in the anticipation of future events, and (b) discussing the techniques that hold significance in the light of this thesis. Effectively, this chapter will address RQ1 and will provide a literature review of scenario-based anticipation methods.

An important remark in this context, is that our research is limited by language barriers. In our literature review, we only focussed on publications written in English, Dutch, German, and, to a lesser extent, Spanish. Additionally, it is conceivable that new scenario methods are (being) implemented in the domain of law enforcement without being documented (yet). We are aware that, being based on only limited literature, some recent initiatives might have escaped our attention.

The chapter starts by delineating the terminology associated with scenarios in section 3.1. We provide definitions for *scenario* (definition 3.1), *scenario model* (definition 3.2), *scenario learning* (definition 3.3), *anticipatory technique* (definition 3.4), and *scenario planning* (definition 3.5). In section 3.2 we discuss the specific usability of scenario planning, and in section 3.3 we examine the effectiveness of scenarios. In section 3.4 we elaborate on methods by which scenarios are developed, and the different approaches to scenarios in relation to the anticipation of future events. Two examples illustrate the variety of situations in which scenario planning can be applied. In section 3.5 we examine the use of scenario models in creative scenario writing, and introduce twelve material elements that constitute a creative scenario. In section 3.6 we take a closer look at some of the models that are used in the field of law enforcement. Although these are not scenario methods in the classical sense of the word, they can be seen as anticipatory techniques. Moreover, they offer valuable insights into the needs of law-enforcement agencies for a model able to anticipate criminal behaviour. In section 3.7 we focus on the limitations of working with scenarios. Section 3.8 concludes this chapter by providing an answer to RQ1.

3.1 Terminology

The first use of scenarios as a way to anticipate future behaviour, is attributed to Herman Kahn in the 1950s, Kahn developed a technique of describing the future in scenarios, that could have been written by people in the future (see subsection 3.1.4). In the years to follow, research institutes and commercial organisations embraced scenario planning as a way to anticipate the uncertainty of the future. The technological developments following the Second World War, and especially the processing powers of computers that developed in the last two decades of the twentieth century, increased the use of scenarios events even further. Yet, over the last 65 years the boundaries between many different terms related to scenarios became somewhat fuzzy. Several of the reviewed studies interchangeably use *scenario, scenario model(ling), scenario learning,* and *scenario planning*. Before we focus on the use of scenarios in the anticipation of future events, we attempt to make a clear distinction between the different terminologies. In other words, in the subsections 3.1.1 to 3.1.4 we attempt to define the concepts used in this study properly.

3.1.1 Scenario

There is neither a single definition for *scenario*, nor for *scenario planning* (see 3.1.4). The word scenario originates from the Italian language and is best translated as "that which is pinned to the scenery". In the *Commedia dell'arte* it was an outline of entrances, exits, and actions that described the flow of a play. The scenario was quite literally pinned to the back of the scenery. The basic idea behind a scenario is, that when the crucial components of a stage play are set, the "flow" of the story between them follows a relatively fixed path.

Nowadays, the word scenario is used in different contexts, and therefore with different definitions. For example, in the creative industry the term scenario is used in relation to art forms that are led by a narrative such as stage plays, fiction films, and novels. In this context, a scenario is defined as *a description of the process of cause and consequences responsible for the (dramatic) plot of a story* (cf. Nekkers, 2006). Another area in which scenarios are commonly known is that of computing. In the design of computer systems or applications, scenarios are employed to represent the use of a system or application and make that use explicit. In this context *scenarios are used to orient design and analysis towards a broader view of computers* (cf. Carroll, 2000). In corporate management circles scenarios are used to anticipate the uncertainties of future events. Even in this rather confined area, there seems to be no unison of definition. For instance: *A scenario is an internally consistent view of what the future might turn out to be* (Porter, 1985), *Scenarios constitute a disciplined method for imaging possible futures in which* *organisational decisions may be played out* (Shoemaker, 1995) and *Think of a scenario as a fairytale or story* (Ringland, 2006).

Based on the aforementioned examples, it is safe to conclude that a scenario is neither a prediction nor forecast[23], but rather a response to the question "what could possibly happen?" In this thesis we define scenario as follows.

Definition 3.1: Scenario

A scenario is a narrative (or a story) that describes foreseeable interactions between characters and the system. A scenario includes information about behaviour, goals, motivations, expectations, actions and reactions, successes and problems.

3.1.2 Scenario model

As argued by Peterson et al. (2002), a scenario model can be used to consider a variety of possible futures that include many of the important uncertainties in the system, rather than to focus on the accurate prediction of a single outcome. To depict this variety, one single scenario is often not sufficient. Therefore scenarios are more often than not used in combination with one another. We define "scenario model" as follows.

Definition 3.2: Scenario model

A scenario model is an arrangement of two or more scenarios that depicts how information about past scenarios (that include information about behaviour, goals, motivations, expectations, actions and reactions, successes and problems), work in an interconnected way to generate an outcome with respect to possible future scenarios.

Scenario modelling evidently is the act of designing a scenario model, or combining different scenarios, in a certain environment.

[23] The difference in meaning between prediction and forecast is rather subtle and both words are often interchangeably used. A prediction is a statement about the way things will happen in the future, often but not always based on experience or knowledge and closely related to uncertainty (Hazem & Mastorakis, 2008). A forecast relies mainly on data from the past and present an analysis of trends. It is an extrapolation of the past into the future (cf. Armstrong, 2001).

3.1.3 Scenario learning

Van der Heijden (1996) supports the view that the main virtue of scenario learning lies in the flexible approach to a situation in which strategic decisions are made and not as much in the specific outcome of the scenarios (cf. Mercer, 2001). We define the concept of "scenario learning" as follows.

Definition 3.3: Scenario learning

Scenario learning is the process of (organisational) learning that occurs during the process of scenario development.

(Van der Heijden, 1996)

3.1.4 Scenario planning

The term *scenario planning* was adopted during the last century by people who were engaged in what was called "future research". The main objective of future research was to create a "framework for speculation" (cf. Kahn & Wiener, 1967) that, in the course of the century, proved to be quite effective in guiding the decision-making process of an organisation. The name "scenario" was embraced to link this approach to that of the creative (film) industry of Hollywood (Ringland, 2006). This indirectly linked scenario planning with its origin, namely with the historical definition of "that which is pinned to a scenery". It is therefore not surprising that the use of scenarios in strategic planning is considered by some more of an art form than a formal methodology. The book titles "The art of the long view" (Schwartz, 1996) and "The art of strategic conversation" (Van der Heijden, 1996) hint at this interpretation. Schwartz plainly states: "Scenario thinking is an art, not a science. But the basic steps are the same."

A search for a clear definition of "scenario planning" within the relevant literature leads to a series of definitions of "scenario" (as described above) as well as a number of generic definitions for "planning". In most literature, rather than defining "scenario planning", the process of scenario planning is described. Chermack (2001) addresses this lacuna: "Even among the most prolific writings on scenarios, it was difficult to find crisp definitions that capture the true meaning of scenario planning".

Ringland (2006) defines scenario planning as "that part of strategic planning that relates to the tools and technologies for managing the uncertainties of the future". This definition is rather broad and implies that any tool and technique can be used for scenario planning, as long as it is used for managing the uncertainties of the future. With this definition, Ringland establishes a direct link between scenario planning and strategic planning. Yet, it is difficult to continue this route. For instance, instead of delivering a "crisp" definition, Kirsch (2004) separates scenario planning from forecasting in the following way: "Scenario planning differs from other forecasting techniques in its underlying epistemology. Whereas mechanistic forecasting techniques try to derive knowledge about the future from objective facts, scenarios try to make sense out of different subjective assumptions about how the world works."

Although the reviewed literature was sometimes more obfuscating than clear, and did not deliver a crisp definition, we found relative consensus in the description of scenario planning. It reads as follows: scenario planning is an anticipatory technique that attempts to describe what possible futures there might be, rather than a tool to predict the future. Although this description of scenario planning relies heavily on *anticipatory technique*, yet another term that needs defining, it concurs with the fundamentals of our research. Reverting to the original meaning of the word, a scenario can be seen as the boundaries between which the actors can improvise. Abiding by that analogy, possible futures can only lay within the boundaries that are set by scenario(s).

Based on the aforementioned findings, we will first define *anticipatory technique*. Next we will build our definition of *scenario planning* on that of *anticipatory technique*.

Definition 3.4: Anticipatory technique

An anticipatory technique is a technique that assists the process of decision-making about future events, based on the interpretation of past events.

Subsequently, "scenario planning" is defined as follows.

Definition 3.5: Scenario planning

Scenario planning is the combination of anticipatory techniques that attempts to describe what possible futures there might lay ahead, based on the use of scenarios.

To distinguish scenario planning from scenario learning (see 3.1.3), List (2005) proposes to focus on where the knowledge is stored. “Scenario planning is recorded on paper while scenario learning is recorded in people’s heads”. Because the focal point of this thesis lies on the design of a scenario model that allows anticipating criminal behaviour, we will primarily direct our attention towards the development of scenario planning. We will elaborate on this subject in the next section.

3.2 Scenario planning

The basic idea of scenario planning is the understanding that the future cannot be predicted (accurately) by forecasting especially when anticipating an unprecedented event. Forecasting distinctly extrapolates historic values onto future situations by assuming that existing trends will continue or similar values will be applicable. Scenario planning offers a different approach to assess the uncertainties of the future and is particularly useful in situations where changes in the environment are recognised but not well understood.

Scenario planning relies on the identification of (a) significant events, (b) the main actors, and (c) their motivations. Moreover, scenario planning relies on recognising (dis)continuity and on creating scenarios that focus on the possible consequences thereof. Because generally there is no single scenario that spans all the consequences of discontinuity, scenario builders create sets of scenarios in which each scenario respects the aspects of the future that are likely to persist, but describes a different way in which an uncertainty could play out.

Below we will focus on the value of scenarios in managing uncertainties (in 3.2.1) and the role of creativity in working with scenarios (in 3.2.2).

3.2.1 Managing uncertainties

For more than thirty years, the Royal Dutch/Shell group has used scenario planning as a fundamental tool in their approach to anticipate the uncertainties in the petrochemical industry. “When we reflect on situations of the future, we see the world through our own frames of reference. The purpose of scenario work is to uncover what these frames are, respecting differences rather than aiming for a consensus that puts them to one side.” (Royal Dutch/Shell Group, n.d.).

The value of scenario planning, or "alternative futures" as it was originally referred to, is clearly described in *The year 2000* (Kahn & Wiener, 1967). "Alternative futures can be used for generating additional scenarios for setting forth and discussing criteria, for the systematic comparison of various alternative policies (or alternative combinations of assumptions and objectives), or for the analysis and examination of specific issues. They are also of interest in making assumptions and context explicit, as should be done, for example in any analysis of 'directions and destinations'. With a set of alternative futures and scenarios that lead to them by alternative routes, one may see better what is to be avoided or facilitated, and one may also gain a useful perspective on the kinds of decisions that may be necessary, and the points in time after which various branching-points will have been passed" (Kahn & wiener, 1967).

The first scenario model that consisted of "Future scenarios" is attributed to Herman Kahn (see Ringland, 2006). Kahn was working for the RAND Corporation, a non-profit and global organisation initially formed to offer research and analysis to the United States armed forces. Kahn was assigned to the military-strategic think-tank that was working on the relation between weapons of mass destruction and US military strategy. He developed "future-now scenarios", a method in which detailed analysis and human creative power were combined, leading to reports (scenarios) that could have been written by people thirty years ahead in time.

Scenarios that were generated by the future-now process foresaw in 1967 that computers ("as easy to operate as a car") would, by the end of the twentieth century, be so sophisticated that they could be used for financial transactions, weather forecasts, and even crime prevention[24] (Kahn & Wiener, 1967). Kahn's findings were taken seriously, not only by the RAND Corporation for which he was working, but also by the US Government who based their military strategy on Kahn's scenarios.

The most prominent scenario model was that in which Kahn reflected on the relationship between the development of nuclear weapons and the possible military response to it. It became renown as the doctrine of "Mutually Assured Destruction" (MAD). This doctrine assumes that when two opposing sides have sufficient nuclear weaponry to destroy the other side, either side (if attacked for

[24] For more examples of predictios that were made through the future-now process, we refer to box 3.

any reason by the other) would retaliate with equal or greater force. The expected result would be an immediate escalation resulting in both combatants' total and assured destruction. The best recipe for peace, as suggested by the MAD doctrine, would therefore be a built-up of nuclear weaponry sufficiently powerful to destroy the enemy state completely (Parrington, 1997). Evidently, this equilibrium or "Mexican standoff" can only exist when the enemy is not allowed to defend itself against nuclear missiles.
The MAD doctrine was generally seen as the key argument for the nuclear arms built-up during the cold war era. The general public perceived the scenarios generated by Kahn, as the root of all evil and the future-now method was held accountable in public debate. Kahn responded, stating that his scenarios were to be seen as descriptions of a possible future and not as predictions. "Remember it's only a scenario, the kind of thing that is produced by Hollywood writers" (Kahn & Pepper, 1979).

In the 1970s, the use of scenarios was rediscovered by the corporate sector. One of the more prominent companies that introduced scenario models in their decision-making process was the *Royal Dutch/Shell Group*. Shell's think-tank detected trends and cycles from data about historical events, combined them with creative powers and projected them into the future. From that projection, certain scenarios were distilled that were introduced in the strategic decision-making process of the company. These scenarios anticipated (i) the energy crises of 1973 and 1979, (ii) the growth in the use of energy, (ii) the rise of the political green movements, (iv) the decline in oil demand, and even (v) the fall of the Soviet Union. By outlining the possible future scenarios, Shell was able to contemplate situations that proved to be crucial for the petrochemical industry. It allowed them to anticipate changes more rapidly and adequately than competing oil companies.

Shell's success indicated the potential of scenario models in a strategic decision-making process. As a result, many companies adopted scenario models as a means to anticipate future behaviour. Nowadays, scenario models are as common in the financial sector as they are in the scientific context, or in educational systems as well as in corporate or governmental use. In all, scenario models have become widely accepted to combine historical trends with creative powers in order to support decision-making processes about anticipating future events (De Geus, 1997).

3.2.2 The role of creativity

From the reviewed literature (Kahn & Pepper, 1979; De Geus, 1997; Kenter, 1998; Armstrong, 2001; List, 2005; Ringland, 2006), we may conclude that the role of creativity and imagination is closely connected with anticipatory techniques in general, and with the use of scenarios in particular. Although it might seem that "anticipating criminal behaviour" and creativity do not blend well, we found evidence that the role of imagination and creativity can prove to be of great value. Below we will briefly discuss our findings.

The terrorist attacks on the World Trade towers in New York on September 11, 2001, jolted "creativity" in the process of counter terrorism. Shortly after the attacks, US Government authorities gathered Hollywood film producers, scenario writers, and developers of computer games and challenged them to put forward imaginative scenarios for possible attacks in the future. "However accurate, inaccurate, responsible, or irresponsible films may be in portraying terrorists or terrorist events, there is no doubt that action films bear predictive power" stated Richard Lindhelm of the *Institute for Creative Technologies* in an interview with Bob Edwards (October 15, 2001). Lindhelm continued: "Since September 11, top army officials have held two teleconferences with top filmmakers. Together they brainstorm possible scenarios involving terrorists, and come up with ideas on how to foil real-life foes. The ad hoc group of moviemakers emerged from a program that has been under way for nearly two years at the University of Southern California. The peacetime purpose of the *Institute for Creative Technologies* is to set the best minds of the entertainment industry to the task of creating state-of-the-art training exercises for soldiers". In the interview, Lindhelm went on to state that "fortunately or unfortunately, art has often led the way to reality, and that art, motion pictures, and ideas coming from writers, have often been the inspiration for reality" (Edwards, 2001).

With these brainstorm sessions, the US Government advanced on the conclusions of The National Commission on Terrorist Attacks Upon the United States (commonly referred to as "the 9-11 Commission"), which led to the conclusion that the US Intelligence community lacked imaginative powers in the period leading up to the 9-11 attacks. "Imagination is not a gift usually associated with bureaucracies. (...) It is therefore crucial to find a way of routinizing, even bureaucratizing, the exercise of imagination. Doing so requires more than finding an expert who can imagine that aircraft could be used as weapons."

(National Commission on Terrorist Attacks Upon the United States, 2004). Notably, the recommendations of the 9-11 Commission regarding imagination and creativity did not become more concrete than this.

3.3 An effective scenario model

For a proper discussion on the application of scenario, it is essential to investigate more closely the elements that define an effective scenario model. In *Scenarioplanning*, Ringland (2006) mentions two elements of a successful scenario model:
(1) the ability to anticipate unexpected real world behaviour which may happen through (a) exploring the constraints or changes in the external environment, or (b) the relationship between forces;
(2) the creation of a mental model that may allow the user to look for early confirming or disconfirming evidence.

Schoemaker (1995) argues that by constructing a series of scenarios (e.g., a scenario model), a decision-maker is able to identify basic trends and uncertainties, enabling him to compensate for the usual errors in decision-making: overconfidence and tunnel vision.

Schoemaker (1995) and Ringland (2006) agree that by combining a series of scenarios, a model may be created that facilitates the decision-makers in exploring the existing forces in a field or domain. A scenario model would enable them to anticipate -unexpected- future ("real world") behaviour, and helps them to validate confirming or disconfirming evidence and to compensate for possible errors in decision-making.

Nekkers (2006) advances on this notion. By creating scenarios on the relationship between (a) the constraints or changes in the external environment and (b) the forces responsible for the dynamics of the external environment, attention is drawn to the underlying structure. This structure in turn can be used to anticipate future behaviour. Nekkers exemplifies his statement by pointing at the solar system. Only since we charted the limitations, the changes, and the correlation of forces between interdependent planets, we are able to predict accurately when and where the next solar eclipse will be visible.

Combining the conclusions by Schoemaker, Ringland, and Nekkers, we characterise an effective scenario model as follows.

An effective scenario model should satisfy three conditions:

1. Offer the possibility to learn from historic criminal behaviour.
2. Offer the possibility to adapt the chosen strategy on the basis of indicators that are found.
3. Offer the possibility to anticipate (unexpected) future real-world behaviour.

An example of how a complex structure of changes in the external environment can be made visible, is given by Kahn & Wiener (1967). In 1967 Kahn tried to make assumptions about a situation more than thirty years ahead in time, the year 2000. He was challenged to study the underlying system of global forces responsible for the changes of the earth and its technological innovations. Kahn devised a method in which he envisioned himself in the year 1900, challenged by the task to "predict" the future of 1933 on the basis of the information that existed in 1900. He then assessed to what extent his predictions deviated from the actual situation in 1933, studied this "offset" and tried to explain the factors responsible for the deviation. Subsequently he repeated the exercise, and imagined himself in 1933 making predictions about 1966. With the data he collected in his previous experiment combined with the offset he calculated, the predictions for 1966 turned out to be reasonably accurate. Again Kahn devoted all his attention to what he did not predict (correctly) in order to be able to assert the dynamics of the underlying system.

Kahn and Wiener (1967) describe the characteristics of this underlying system as follows: "the current and future pace of change and the likelihood of unexpected developments, significant clusters of events, qualitative changes in the combination of trends and emergent properties, such as the increasing self-consciousness of time and history."

Only after Kahn had valued the underlying system (in which he now incorporated the offset), he dedicated his attention to the actual task of predicting the future of the year 2000 (see box 3).

Box 3: A “future now” illustration

To what extent Kahn and Wiener were able to predict the future accurately is hard to ascertain but they adequately predicted technical innovations that helped shape the modern world. In *The year 2000* (Kahn & Wiener, 1967) a table was included titled "One Hundred Technical Innovations Very Likely in the Last Third of the Twentieth Century." Below we single out eight predictions from this table as thought-provoking examples.

1. Extensive and intensive worldwide use of high altitude cameras for mapping, prosecuting, census, land use, and geological investigations.
2. Extensive use of cyborg techniques (mechanical aids or substitutes human organs, senses, limbs, or other components).
3. Three dimensional photography, illustrations, movies and television.
4. New techniques for very cheap, convenient and reliable birth control.
5. Automated universal (real time) credit, audit, and banking systems.
6. Simple inexpensive home video recording and playing.
7. Other widespread use of computers for intellectual and professional assistance (translation, teaching, literature search, medical diagnosis, traffic control, crime detection, design, analysis, and to some degree as intellectual collaborator in general).
8. Personal “pagers” (perhaps even two-way pocket phones) and other personal electronic equipment for communication, computing, and data processing program.

3.4 Scenario development

In the scholastic literature a number of different processes are described in which scenario models can be developed (see, e.g., Ducot & Lubben, 1980; Duncan & Wack, 1994; Heugens & Van Oosterhout, 2001; Postma & Liebl, 2003; Van Notten, 2006). The typology offered by Van Notten is the most recent of these studies. Moreover, his work draws on earlier research. In this thesis we will therefore adopt the typology offered by Van Notten. By incorporating earlier typologies, he captures the full range of contemporary scenario development. In subsection 3.4.1, we will focus on the typology of approaches proposed by van Notten. In subsection 3.4.2 we will illustrate this by two examples.

3.4.1 A typology of approaches

Van Notten (2006) proposes a typology of scenario development, by which he identifies three broad “macro-characteristics” that are argued to be central in the development of scenarios: (1) the project goal, (2) the scenario process, and (3) the scenario content. Essentially, these three macro-characteristics represent the why, how, and what of a scenario model. Below, we will describe them briefly.

1 Project goal

The first macro-characteristic that Van Notten (2006) deems to be central in the development of scenarios is the goal of the project. According to Van Notten, there are two poles of the spectrum in relation to the project goal: (1a) exploration, and (1b) pre-policy research. However, a project goal may consist of (1c) a fusion of these types of goal.

1a Exploration

The goal of the scenario study may be the exploration of possible future situations. Exploration in this case constitutes learning, awareness raising, stimulation of creative thinking, and investigating the relationship between societal processes. When dealing with an exploratory scenario, the process of coming to scenarios is as important as the scenarios themselves.

1b Pre-policy research

Scenarios that are generated with the goal of pre-policy research constitute concrete options for strategic decision-making. These scenarios are used to examine paths to future situations that vary according to their desirability, and are often valued as (a) desirable, (b) conventional, or (c) undesirable.

1c: Fusion of goals

In practice, the two types of goal (exploration and pre-policy research) are often coalesced into a fusion. In such a scenario method, exploratory scenarios are developed initially to investigate a field that is too general to serve as the basis for decision-making (for instance, when there are uncertainties on a global level). Subsequently, case-specific scenarios are developed that help focus on pre-policy research and strategy development.

2 Process design

The second macro-characteristic of Van Notten's typology addresses the methodological aspects of scenario development. A basic distinction, Van Notten argues, is that between (2a) analytical, and (2b) intuitive approaches to the process design. Analytical approaches are commonly used for pre-policy processes while intuitive approaches are generally used for exploratory purposes. Moreover, Van Notten (2006) distinguishes (2c) a hybrid approach.

2a An analytical approach

Within the analytical approach Van Notten recognises model-based techniques and desk research. Model-based techniques tend to be based on quantified knowledge and often rely on computer models in the development of scenarios. In desk research, scenarios are developed through data analysis or research. This is a less formalised and systematic approach than the model-based forms, but may be just as rigorous (cf. Van Notten, 2006).

2b An intuitive approach

The intuitive approach relies heavily on qualitative knowledge and insights as sources for scenario development. Creative techniques such as the development of narrative stories (in workshops) are good examples. In the intuitive approach, scenario development is often regarded as a form of art in which coherent stories are generated from, e.g., associations and creative input.

2c A hybrid approach

According to Van Notten (2006), there have been attempts to combine the analytical and the intuitive approach to the extent that intuitive approaches support a mainly analytical approach. Genuine hybrid approaches, in which both analytical and intuitive approaches are merged, are highly exceptional and experimental.

3 Scenario content

The third macro-characteristic addresses the question of the composition of the scenarios. It examines the nature of variables and dynamics in a scenario, and how they interact. Van Notten (2006) distinguishes (3a) straightforward scenarios and (3b) complex scenarios.

3a *Straightforward scenario*

Straightforward scenarios are composed of a limited number of variables and are limited in scope.

3b *Complex scenarios*
Complex scenarios are composed of an intricate web of many related variables and dynamics. Complex scenarios distinguish alternative patterns of development and can use multiple temporal or spatial scales.

3.4.2 Two examples

The three macro-characteristics (viz. project goal, project design, and scenario content) are strongly correlated. The project goal dictates to a certain extent the process design, which in effect influences the content of the scenario model. To illustrate the way the macro-characteristics proposed by Van Notten can interact, we discuss two distinctly different scenario models that were created in contrasting environments. The particular examples illustrate the broad field in which scenario models can be applied, and additionally demonstrate the close relation between (a) the environment in which the scenario process is set and (b) the final design of the scenario model.

Below we will present (1) an example of a scenario generated by an analytical approach and (2) a scenario generated by an intuitive approach. We conclude this subsection by discussing their impact.

1: An analytical approach

An example of a scenario model that was generated through an analytical approach is *The limits to growth* report (Meadows et al., 2004). The Club of Rome, an international group of business people, state officials, and scientists, essentially commissioned *The limits to growth* for explorative purposes, to be used for pre-policy decision-making. The two-year study behind the report took place at the Massachusetts Institute of Technology with the objective to predict the consequence of the rapidly growing world population and the finite resource supplies, particularly oil. It was based on a computer simulation (named "World3") that explored the interactions between population, industrial growth, food production, and the limits in the ecosystems of the Earth. The computer model consisted of several interacting parts. Each of these dealt with a different system of the model. Calculations of the outcomes of the model were based on data retrieved from the past. The main systems were: (a) the food system (dealing with agriculture and food production), (b) the industrial system, (c) the population system, (d) the non-renewable resources system, and (e) the pollution system.

The scenario methodology used in *The limits to growth* of presenting various future options, appeared incomprehensible to many readers, who therefore paid attention only to the disastrous "growth scenario" (see Nørgård, 2010). As a result, *The limits to growth* was criticised by many prominent economists, scientists, and political figures. It became one of the most famous and controversial examples of the use of scenario models. The report sold 12 million copies in more than 30 translations, making it the best-selling environmental book in world history (Meadows et al., 2004).

2: An intuitive approach

Scenario models can also be generated in a much more intuitive way. This is exemplified by the *Mont Fleur scenarios*, which were used against the backdrop of a rather critical political power change in South Africa.

In 1992, a diverse group of 22 prominent South Africans -politicians, activists, academics, and businessmen, from across the ideological spectrum- came together at the Mont Fleur conference centre with the aim to develop and disseminate a set of stories about what might happen in their country over the decade spanning 1992 to 2002. The purpose of Mont Fleur was "not to present definitive truths, but to stimulate debate on how to shape the next 10 years."

From strongly different perspectives, they set out to build a shared map of South African reality. After considering many possible stories, the participants agreed on four scenarios that they believed to be plausible and relevant. They were called Ostrich, Lame duck, Icarus, and Flight of the flamingos.

1. Ostrich is characterised by the fact that a negotiated settlement to the crisis in South Africa is not achieved, and the country's government continues to be non-representative.
2. Lame duck is characterised by the fact that a settlement is achieved but the transition to a new dispensation is slow and indecisive.
3. Icarus is characterised by the fact that a transition is rapid but the new government unwisely pursues unsustainable, populist economic policies.
4. Flight of the Flamingos is characterised by the fact that the government's policies are sustainable and the country takes a path of inclusive growth and democracy.

The group developed each of these scenarios into a brief logical narrative. The participants subsequently presented and discussed the scenarios with more than fifty other groups, including political parties, companies, academics, trade unions, and civic organisations. Because of reasons of accessibility to a large audience, the stories were disseminated via newspapers, cartoons, and a short film (Beery, Ednow, & Murphy, n.d.).

3: Impact

While the value of both *The limits to growth* models and the *Mont Fleur* scenario models are hard to objectify (much less to compare), both models did have a significant impact on the public debate. In that respect both the models met the criteria for effective scenario planning set in section 3.3: They clearly provided an exploration of the relationship between the constraints or changes in the external environment and the forces responsible for the dynamics of the field of investigation.

3.5 Creative scenarios

Scenarios generated in the creative industries (e.g., film, theatre, and fictional literature) have no relation whatsoever with (strategic) planning and have no need to be predictive in any way. However, they do have to be plausible. "Actions should be logical and follow naturally from actions that precede them. They will be more satisfying to the audience if they come about by surprise or seeming coincidence and are only afterward seen as logical, even necessary." (Aristotle, trans. 1987).

Below we will focus on the theory of creative scenarios by referring to (i) *Poetics*, (ii) *the Golden W's*, (iii) *the seven basic plots*, and (iv) *the material scenario components*.

Poetics

The earliest surviving work of dramatic theory is Aristotle's *Poetics* (335 BCE). Aristotle is credited for being the first to analyse creative literature and to describe the set of principles responsible for dramatic construction (Janko, 1987). "Poetics" in Aristotle's opinion, includes drama (comedy, tragedy, and satyr) and is essentially a "mode of imitation" or representation of "our world of appearance". From chapter VII of *Poetics* (The Plot must be a Whole), a paradigm is derived that became one of the basic maxims of creative scenario writing: A scenario represents the unities: action, place, and time. In addition to this concept, Aristotle proposed a model of six essential parts that constitute tragedy and subsequently drama: “Every Tragedy, therefore, must have six parts, which parts determine its quality, namely, Plot, Character, Diction, Thought, Spectacle, Song. Two of the parts constitute the medium of imitation (*Plot, Character*), one the manner (*Diction*), and three (*Thought, Spectacle, Song*) the objects of imitation. And these complete the list.” (Aristotle, trans. 1987) *(Terms in italic are added by the author of this thesis)*.

The Golden W’s

Hermagoras of Temnos (first century BC), the Ancient Greek rhetorician and teacher of rhetoric in Rome, divided “a topic” into “seven "circumstances". He defined these circumstances as the loci of an instance: *Quis, quid, quando, ubi, cur, quem ad modum, quibus adminiculis*. These sources can be translated as: Who is it about? What did happen? When did it take place? Where did it take place? Why did it happen? In what way did it happen? By what means did it happen? These seven circumstances provided the roots of the "Golden W's" that are nowadays used in journalism, education, and police investigation where they are supposed to ensure thoroughness in the coverage of a particular incident or subject matter.

We note that the Golden W’s are frequently referred to as “5W’s” (Who, What, When, Where, Why), “5 Ws and an H” (Who, What, When, Where, Why and How), or “7 W’s” (Who, What, When, Where, Why, In what Way, and With what) (Robertson, 1946). In this thesis we will use the term “Golden W’s”.

The seven basic plots

In *Seven basic plots*, Booker (2007) suggests that narratives serve to pass along moral lessons and models from the older generation to their children and successors. As a result the basic lessons have coalesced over time into seven basic symbolic “plots” that have formed the primary model for storytelling into the present day. The seven plots Booker defines are as follows:

1. *Overcoming the Monster*; Stories in which a hero must defeat a monster and restore order to a world that has been threatened by the monster’s presence.

2. *Rags to Riches*; Stories that feature modest, generally virtuous but downtrodden characters, who achieve a happy ending when their special talents or true beauty is revealed to the world at large.
3. *The Quest*; Stories in which a hero, often accompanied by sidekicks, travels in search of a priceless treasure and fights against evil and overpowering odds, and ends when he gets both the treasure and the girl.
4. Voyage and Return; Stories of normal protagonists who are suddenly thrust into strange and alien worlds and must make their way back to normal life once more.
5. *Comedy*; Stories (not necessarily humorous in nature) that involve some kind of confusion that must be resolved before the hero and heroine can be united in love.
6. *Tragedy*; Stories that relate the terrible consequences of human overreaching and egotism.
7. *Rebirth*; Stories which focus on a threatening shadow that seems nearly victorious until a sequence of fortuitous (or even miraculous) events lead to redemption and rebirth, and the restoration of a happier world.

The material scenario components

Studying the rules of Aristotle's *Poetics*, the quality of imitation (see the description of *Poetics* above) became the source of debate among scholars of drama in the beginning of the 1990s. At that time, the author of this thesis was a student at the Film Academy[25] in Amsterdam, the Netherlands.

In a metaphysical search for the basic ingredients of a scenario, one of the lecturers of the Film Academy, claimed that the number of components from which a scenario can be built is finite, but was yet to be determined (Saaltink, 1990). Saaltink challenged the author to use the process of "reverse engineering"[26] in order to compile a list of material components of all the films and books that were to be studied during the four-year course. To demarcate (a) material components such as character, place, and time, from (b) elements that

[25] Netherlands Film Academy (NFA): Amsterdam School of the Arts.

[26] "Reverse engineering" refers to the method of analysing a subject system to create representations of the system at a higher level of abstraction (Chikofski & Cross, 1990). In this case, stories were "taken apart" in order to discover the components they were built from.

relate to the style or the way a story is told, such as "diction", Saaltink referred to Aristotle's *Poetics*.

In the course of four years, the discourse led to a list of twelve material scenario components, compiled by the author of this thesis. This result postulated the theory that every conceivable story can be constructed from a combination of:

1. Arena
2. Time(frame)
3. Context
4. Protagonist
5. Antagonist
6. Motivation
7. Primary objective
8. Means
9. Modus operandi
10. Resistance
11. Symbolism
12. Red herring

Ever since the compilation of this list in 1990, the author of this thesis has been challenging these scenario components by disparate narrative works of fiction[27] such as films, books, theatre plays, and verbal stories from different cultural origin. From these observations, very prudently, the conjecture was formulated that every narrative can be disassembled into twelve material scenario components.

It has to be noted though, that while a story or scenario can be composed from the twelve material components, not every element has to be present in a scenario.

Here we would like to remark that the material scenario components listed above, encompass the components of criminal behaviour offered by the criminal theories highlighted in subsection 2.2.4 (viz. *context*, *primary objective*, *motivation*, and *resistance*). The scenario component *Antagonist* refers to the component of criminal behaviour that in the Routine activity theory is named *Target*.

[27] We regard as work of fiction any work that deals, in part or in whole, with information or events that are not real but rather imaginary and theoretical - that is, invented by an author.

In chapter four we will elaborate on the aforementioned scenario components, as they will be implemented in the conceptual design of the scenario model. For now it is sufficient to note that creative scenarios are built on the notion that there is a finite number of "essential components" from which scenarios are created.

3.6 Proactive models in law enforcement

In spite of extensive research into the models that are in use in law enforcement worldwide, we failed to find evidence that scenario methods are used to anticipate criminal behaviour. However, we did discover models (not based on scenarios) that were either used, or specifically designed for proactive purposes. In these models data is collected that (apart from being saved for analytical reasons) can be put to proactive use.

Additionally, we found that scenarios in law enforcement are primarily used in a reactive way, in other words, to reconstruct a situation that occurred. To distinguish the reactive use from the anticipatory (proactive) use, we describe the two different approaches to crime separately in subsections 3.6.1 and 3.6.2, respectively. In subsection 3.6.1 we will focus on the reactive way by which scenarios are used within the domain of law enforcement. In subsection 3.6.2 we will focus on law-enforcement models that are designed, or may be utilised, for anticipating future incidents. As these models offer insight (both with respect to structure and content) into the possible desires for anticipation in law enforcement, we studied three of these models (International Bomb Data Centre Working Group, Terrorist Planning Cycle, and the IRIS model) explicitly.

3.6.1 Reactive use

Within the domain of law enforcement, scenarios that are used in a reactive way are exploited to reconstruct a situation that took place in the past. We would like to emphasise that this approach does not concur with the definition of scenario that is used in our thesis. We define a scenario as "a narrative describing <u>foreseeable</u> interactions…" (see definition 3.1).

The reactive use of scenarios does neither describe foreseeable interactions (they merely describe plausible interactions), nor do they relate to the scenario components listed in section 3.5. Derksen (2009) argues that the use of the word scenario in a reactive context is clearly a *contradictio in terminis*, for scenarios are used to look forward. However, the term *scenario* in law-enforcement context is sometimes used to describe situations that took place in the past. To distinguish scenario as defined in our thesis from [scenario] used in a reactive context, we have placed the latter between brackets. (Something that exclusively happens in this subsection.)

To exemplify the reactive use of scenarios in law enforcement, as well as to illustrate the difference between a [scenario] and a hypothesis, we adopt an example given by Derksen (2009). Let us assume a body is found in a way that raises suspicion of homicide. Investigative services will immediately draw their attention to the situation that might have led to that specific point in time. When avenues of investigations fail to lead to a plausible case, or when tunnel vision is expected, an investigative team might resort to the use of [scenarios] and hypotheses.

An explanation for the term *hypothesis* that is viable for the use in the context of law enforcement is given by McDowel (2009) in his book *Strategic Intelligence*. It reads as follows. "A hypothesis may be thought of as a conclusion or assumption you may reach about anything at all. It doesn't have to be right; it only has to be realistic and reasonable in terms of being able to be right! In other words, a hypothesis is a plausible explanation. The hypothesis doesn't represent the end of your problem solving activity; it is just a point en route to formulating your final interpretation." (McDowell, 2009)

Going back to the previous example where human remains have been found, there can (only) be four hypotheses.

1. The person died of natural cause(s)
2. It is a case of suicide
3. The person died as a result of an accident
4. The person died as a result of a criminal offence

In essence, the four hypotheses concern with what might have happened while [scenarios] are concerned with how the specific hypotheses might have come about (Derksen, 2009).

For every hypothesis several [scenarios] can be constructed. These [scenarios] are generated as a result of a creative process. Often, participants in the process engage in brainstorm or mind-map sessions. In these sessions, experts and professionals study a specific situation in detail, after which [scenarios] are developed intuitively. For every specific hypothesis, an ensemble of [scenarios] is developed. This method, by nature, lacks a standard procedure. The [scenarios] are limited by imagination only, and may seem far-fetched. For instance, in the case of the aforementioned hypothesis 4, [scenarios] could include a situation in which (a) the deceased was murdered as a result of mistaken identity, or (b) someone aided the deceased in committing suicide (Derksen, 2009).

Two points of critique on this method are: (i) the way these [scenarios] are generated is limited by the visions and creativeness of the participants, and (ii) there is no transparency in the way they are generated. Although these points of critique might be true, the use of intuitive scenarios in reactive use, is reported to have good results when compared to actual outcomes (cf. Van der Heijden, 1996; List, 2005).

3.6.2 Proactive use

Within the domain of law enforcement, many different models are being used globally (cf. US Army Training and Doctrine Command, 2007; Berenschot, 2010; Koeman, 2010). In our review we distinguish three broad categories: (1) models that are designed for data collection, (2) descriptive models that are designed to discover or describe a generic development, and (3) models that are designed to quantify variables. To demonstrate the differences between these models and to expose the virtues they can offer in the light of this thesis, we carefully selected three specific models as specimen of these categories.

Ad 1: The majority of models that are designed for data collection in the domain of law enforcement is designed to log and compare incidents in a specific problem field. Although originally built for analytical purposes, they can be used in a proactive way. For instance, mining the data accumulated in a model can lead to trend detection. The "International Bomb Data Centre Working Group" which we will discuss below, is an example of this.

Ad 2: Other models, such as the Terrorist Planning Cycle described below, are created to gain insight into, for instance, the path that leads from motivation to violence. This type of models seeks to describe generic cycles, and is not designed for data collection.

Ad 3: The IRIS model reviewed below, is an example of a model created to quantify variables of a complex and current situation in order to suggest prospective actions.

Below we will describe the three examples given above, in more detail.

1 International Bomb Data Centre Working Group

The International Bomb Data Centre Working Group (IBDCWG) is a working group of law-enforcement bomb data centres from around the world. Over 25 countries accumulate information about incidents involving arson and the criminal use of explosive materials.

At the heart of the IBDCWG is a intuitive database that allows any member law-enforcement agency to store, maintain, and share securely all of its data relating to critical incidents involving incendiarism and explosive materials (retrieved from xpect-software.com on 23-02-2011).

The information included in the database is quite detailed. Every explosive that is found is carefully scrutinised and dissected. Each cable, resistor or battery is separately logged and added to the dataset. This offers the possibility of linking (parts of) devices over time and space. Every day, between 60 and 70 items are included in the database. Apart from details about the explosives themselves, media clippings, manuals, and open-source information are added. When first responders such as bomb technicians, come across an explosive device, they can upload a picture of it to the IBDCWG where it will be analysed and matched against the database in "near real time". In this way emergency services can obtain a better understanding of the nature of a device and its components, and identify ways to conduct safe procedures.

The power of a working group like this may be illustrated by an example. Following the London attacks of July 7th 2005, several house searches were conducted by investigators of New Scotland Yard. In one of these premises, a number of chemical ingredients were found together with a note that, to the investigators, looked like a recipe of some sort. On the list was the word "maganese". When analysts ran this word against the IBDCWG database, it became clear that almost certainly "manganese" was meant, an ingredient often used to create an explosive mixture. More importantly, the database came up with a handwritten note containing a recipe for explosives that was seized from a well-known terrorist organisation in the 1980s. The list of ingredients not only matched the chemicals found in London, a remarkable spelling error marked one of them: "maganese".

Thus, a seemingly random list of chemicals found in London in 2005 could actually be linked to a recipe for home made explosives of a terrorist organisation from the 1980s. This link proved to be valuable in providing evidence of malicious intent as well as in proving a criminal connection between two terrorist organisations (Berenschot, 2010).

2 Terrorist Planning Cycle

Terrorist operations are typically prepared to minimise risk and achieve the highest probability of success. Terrorists avoid an adversary's strengths and concentrate on its weaknesses. It normally means minimising the number of attackers needed to conduct an operation successfully, while providing them with the most effective weapons available. Usually, terrorists act according to the Terrorist Planning Cycle (TPC) that consists of seven stages that are described below and depicted in figure 3.1. The description of the TPC and its seven stages is based on the US Army Training and Doctrine Command (2007).

The Terrorist Planning Cycle assumes that the people who are planning a terrorist attack follow a fixed path. A potential terrorist first has to define the objective of an attack. Although not mentioned as separate stage in the TPC, this is a rather defining step in the process of planning an operation. For the objective of the terrorist(s) is closely linked to other stages in the TPC such as Stage 1, the *broad target selection* (see figure 3.1).

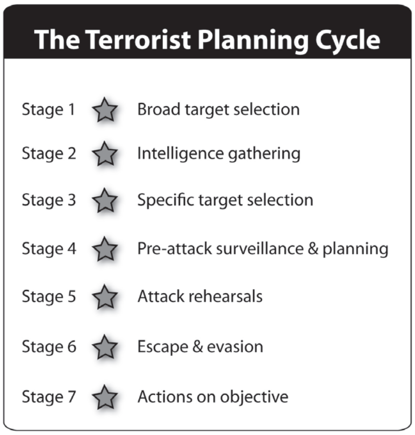


Figure 3.1 The Terrorist Planning Cycle.

Stage 1. The *Broad target selection* encompasses the process of selecting a target that correlates with the objective of the terrorist (organisation). The target may be selected specifically (e.g., a specific person such as a tsar or king), or generally (e.g., a government building). The symbolic value of the target may be a decisive factor in the process of broad target selection. (To illustrate the importance of symbolism, we refer to subsection 2.3.2 where we explain terrorism as a form of communication.)

A second objective of a terrorist (organisation) may be the level of grievance that can be achieved by a terrorist attack, the media attention it may generate, or the elimination of an opponent. Every single objective (or a combination of objectives) leads to another, broad target selection. Only when the overall aim of the attack is defined and the process of broad target selection has been completed, a terrorist (organisation) moves to Stage 2.

Stage 2. In this stage of *Intelligence gathering*, intelligence has to be collected about the different possible locations that suit the overall objective. Intelligence can be gathered in many different ways: From surveillance to OSINT, HUMINT[28], or solicitation. In most cases however, intelligence is gathered by a combination of techniques.

[28] OSINT: Open-source Intelligence. HUMINT: Human Intelligence

Stage 3. In this stage the *Specific target selection* takes place. The explicit elements that define the target selection, are contemplated. Three prevailing factors are: (a) the accessibility of a target, (b) the (financial) resources that the terrorist organisation has, and (c) the level of training it takes to carry out the attack.

Stage 4. The stage of *Pre-attack surveillance & planning*. At this stage the definitive target is put under (close) surveillance and observation and the final planning of the attack commences. This stage can be crucial in the detection of a terrorist attack as, for the first time in the cycle, there is a direct connection between the target and the terrorist (organisation).

Stage 5. This stage encompasses the *Attack rehearsal*. To improve the odds of success, terrorists conduct rehearsals to confirm planning assumptions and to develop contingencies. In this stage (often for the first time) the actual operators are brought directly into the specific arena. This stage may include the actual testing of the security or vulnerability of the target.

Stage 6. The stage of planning *Escape & evasion* addresses the issues of safe exfiltration and the possible evasion of reacting forces. Even in those cases where the self-chosen death of an attacker is believed to enhance the impact of a terrorist attack, exfiltration and evasive plans may be made for the support personnel and possible handlers.

Stage 7. Once terrorists reach the final stage, called *Actions on objective*, undetected, they are sufficiently prepared to turn the odds favouring a Successful incident against the target. Because of the extensive preparation through surveillance and reconnaissance, the terrorists now possess the advantage of the initiative as well as the choice of time, place, and conditions of an attack. Still two matters are important: (i) security measures will be planned for and possibly neutralised, and (ii) employment of support positions will be arranged to neutralise possible reaction forces.

A stage that is sometimes overlooked and not directly linked to the TPC is that of the exploitation of an attack. Exploitation relates to the primary objective of the operation. Some successful operations need to be claimed to achieve the intended effect. Depending on the objective of the operation, Successful incidents can bring favourable attention and (financial) support to the terrorist organisation. However, in some cases there is no need for exploitation. One can imagine that when the primary objective of an operation is to eliminate an opponent, the organisation is benefitted by as little attention as possible (US Army Training and Doctrine Command, 2007; Berenschot, 2010).

3 The IRIS model

The IRIS model is used by the Royal and Diplomatic Protection Service in the Netherlands (In Dutch: Dienst Bewaken & Beveiligen; DB&B). The IRIS model is a proactive model that quantifies the risk of a protected person being subjected to an attack. The overall model consists of three basic models.

The first basic model contains the actual profile of the protectee. In this model, the behaviour of the protectee, his or her recent media appearances and the political pressure are taken into account. The second basic model is an attack model that contains possible opposing forces: (groups of) people that might pose a threat to the protected person. The third basic model focusses on the possible opportunities that a potential attacker has in approaching the protectee. The latter quantifies, for instance, the agenda of the person that is protected and addresses questions concerning the publicity of schedules and appointments.

Every model generates a specific risk profile that is visualised in a colour ranging from low risk (green), via medium risk (orange) to high risk (red). The combinations of the three models are gathered in an overall matrix that suggests possible interventions.

In the time that the IRIS model has been used, it became obvious that the attack model offers the greatest challenge. Two questions are prevalent: (i) which group uses which Modus operandi? and (ii) how to project emerging trends on a future incident? The answers of this model resembled an “educated guess” (Koeman, 2010).

3.7 Limitations of scenarios

Below we discuss three limitations of scenarios: (1) limited availability of information, (2) oversimplification, and (3) inaccurate data.

3.7.1 Limited availability of information

First and foremost, it seems that information about the effectiveness of scenario methods is generally not published (cf. Kirsch, 2004; List, 2005; Chermack, 2011). As this chapter is based on a literature review, it can only study published literature, which generally directs its attention to the methodology rather than review the specific outcomes of completed scenarios.

Concerning the availability of information on scenarios, List (2005) states: "details about the usage, application and effectiveness of the methods are generally not available." Chermack (2011) explains the lack of information by stating "none of the existing texts on scenario planning provides a theoretical explanation of how scenario planning works, and none provides detailed accounts of inquiry into what the outcomes of the experience really are. Nor do any cover a variety of methods for putting scenarios to use and checking to see that they were effective." This could suggest that either scenario planning is generally regarded as quite successful, or that negative results have not been published.

Kirsch (2004) concludes that the overwhelming majority of literature is in favour of scenario planning. Little critical contributions have been published with regard to the theory of the technique itself, nor have failed scenario attempts been reported. Therefore, it seems likely that the information on the use of scenarios is suppressed. "Scenario planning, developed in practice and proprietary in nature, is gaining exposure to academic examination, but has not been thoroughly documented as a discipline or process" argues Chermack (2011). Clearly, suppression of information for whatever reason is a limitation of scenarios that has to be taken seriously and that deserves closer investigation.

3.7.2 Oversimplification

While publications on the effectiveness of scenarios are scarce, we found evidence of a limitation of the use of scenarios that can best be described as oversimplification. It is speculated that planners over-simplify the use of scenarios, confusing the nature of storytelling with forecasting (see Godet & Roubelat, 1996;

Ringland, 2006; Chermack, 2011). In a Harvard Business Review article from 1971, scenario techniques were defined as "Subjective guess work and imagination; in general the methods used are non-scientific" (Chambers et al., 1971). While this notion is likely to have surrendered under the augmentation of scenario planning over the last four decades, a persistent concern associated with the role of creativity is oversimplification.

As illustrated by the examples of *The limits to growth* and *Mont Fleur* scenarios, every model can possess its own virtue. However, both these scenarios merged historic trends with creative powers and this combination proves to be emblematic for an effective scenario model.

However, the danger of scenarios that oversimplify real-world dynamics is illustrated by an example by Nekkers (2006). On the basis of historical data and population growth rates, predictions were made about the future number of inhabitants of New York. In the mathematical calculations, a certain margin of error was built to compensate for possible inaccuracies, yet no intuitive or imaginative scenarios were included in the model. The mathematical margin of error could not exclude that, nine months after a power outage in large parts of New York, all predictions were rendered useless (cf. Nekkers, 2006). On the basis of this example, Ringland (2006) argues that combining historic trends with the power of creative minds, reduces the chance of oversimplifying the future.

3.7.3 Inaccurate data

The accuracy of scenario models seems to be a persistent ground for disapproval. Ringland (2006) states: "The predictions for real life are only as good as the ability to contain enough of the rules and constraints of real life". The data brought in the system can be regarded as the building blocks of prospective scenarios. It seems evident that corrupt or inaccurate data ultimately will lead to inaccurate projections. Obviously, inaccurate data is a limitation of scenarios.

Nevertheless, many theorists dispute the suggestion that accuracy of future situations is the main objective of a scenario method (cf. Kahn & Wiener, 1967; Nekkers, 2006). They argue that scenarios are not to be seen as predictions, but merely as an instrument for strategic discussions. Inaccuracy therefore, does not have to be a reason to criticise the use of scenarios. The project goal effectively will define the level of acceptable inaccuracy (see Van Notten, 2006).

One way of dealing with the aforementioned limitations of scenarios (viz. suppressing information, oversimplification, and inaccurate data) is to allow access to the original data source.

3.8 Answer to research question 1

In this chapter we addressed the first research question (see section 1.5) [*What does previous research on scenario-based anticipation methods offer that is relevant for the development of a scenario model by which criminal behaviour can be anticipated?*]. To address this RQ, we conducted a review of the literature on scenario-based anticipative techniques.

Our literature review leads to the following six observations. They are followed by a general conclusion and a specific conclusion.

Observation 1: In the literature related to scenario-based anticipation methods, we have observed different definitions of terms. From the reviewed literature, we formulated definitions of *scenario*, *scenario model*, *scenario learning*, *anticipative technique*, and *scenario planning* (see section 3.1).

Observation 2: From the reviewed literature we may conclude that scenario planning relies on (a) the identification of significant events, (b) the main actors, and (c) their motivations. Moreover, (d) scenario planning relies on recognising (dis)continuity and (e) on creating scenarios that focus on the possible consequences thereof (see section 3.2).

Observation 3: Based on the reviewed literature on scenario development, we conclude that an effective scenario model should satisfy three conditions:

1. Offer the possibility to learn from historic criminal behaviour.
2. Offer the possibility to adapt the chosen strategy on the basis of indicators that are found.
3. Offer the possibility to anticipate (unexpected) future real-world behaviour.

Observation 4: Scenario development literature offers important lessons in the design of a new scenario model as it reveals the relation between (a) the project goal, (b) the design of the scenario process, and (c) the contents of the scenarios (see section 3.4).

Observation 5: Study of creative scenarios reveals twelve material components (viz. *Arena*, *Time(frame)*, *Context*, *Protagonist*, *Antagonist*, *Motivation*, *Primary objective*, *Means*, *Modus operandi*, *Resistance*, *Symbolism, and Red herring*) by which a story or scenario may be built. These components suggest an analogy between the way a criminal investigation is conducted and the way a creative scenario is built. The scenario components encompass five components that were highlighted in the discussion of the criminal theories in subsection 2.2.4 (viz. *Context*, *Antagonist*, *Motivation*, *Primary objective*, *Resistance*) (see section 3.5). Moreover, the elements *Symbolism,* and *Red herring* may emerge as valuable elements in the design of a new scenario model. Therefore, the twelve material components may offer important opportunities in the design of a scenario model able to anticipate criminal behaviour

Observation 6: An investigation into the literature about models used in law enforcement reveals no examples that scenario methods have been used in an anticipative, proactive way. However, it does reveal three models that may be used for anticipating future incidents but these models are not based on scenarios.

6a: The model that is used by the IBDCWG illustrates (i) the value of comparing different, seemingly unattached incidents, and (ii) the accumulation of detailed information, and (iii) illustrates the need for a structural anthology of data (cf. Berenschot, 2010).

6b: The Terrorist Planning Cycle is used to exemplify the value of identifying general patterns of behaviour in the conduct of criminals. Patterns of behaviour that can be detected from historic incidents, offer opportunities of anticipation of prospective incidents (cf. US Army Training and Doctrine Command, 2007).

6c: The IRIS model underlines the importance of defining progression in the development of a criminal act. It offers the opportunity to think ahead and to devise plans to intervene on stages that might occur in the future (cf. Koeman, 2010). This is the essential component for a model able to anticipate criminal behaviour (see section 3.6).

General Conclusion:
Based on the literature studied, we may conclude that an effective scenario model is able to accumulate different historic criminal incidents in a systematic way.

Specific conclusion:
From the general conclusion and the six observations listed above, we further conclude that an effective scenario model will (i) store knowledge and experience gained from previous situations, that in turn can be used for (ii) detecting and analysing trends and unexpected relations. Subsequently, these trends and relations can be extrapolated towards the future to (iii) assist in anticipating future incidents.

The findings of the literature review discussed above will guide the design of a scenario model fit for anticipating criminal behaviour in chapter five. Moreover, we will argue that the material scenario components offered by creative scenarios will be used in a novel way of modelling criminal behaviour. This will be the subject of the next chapter.

4

"Crime is behaviour. Like many other patterns of behaviour, even the most serious violent crime frequently can be characterized, categorized, anticipated, and hopefully even predicted. (...) If it were not predictable, we would not have the field of criminal profiling. We would also not have as many interesting movies or books."

Data Mining and Predictive Analysis[29]

FOUR | Modelling criminal behaviour: ESC12

In this chapter we will propose a new way of modelling criminal behaviour based on the twelve components that are essential in creating a scenario.

[29] In Data Mining and Predictive Analysis (2007), Colleen McCue describes the possibilities for data mining to assist law-enforcement professionals.

As indicated by the words at the beginning of this chapter, McCue (2007) states that criminal behaviour, like other human behaviour, needs to be characterised and modelled, in order to be used for predictive analysis. Moreover, McCue relates predicting criminal behaviour to creative writing.

Elaborating on the study by McCue (2007) we will argue that the twelve material components of a scenario derived from the field of creative writing (see section 3.5), may offer significant advantages in the categorisation and anticipation of criminal behaviour. Therefore, we will adopt the material scenario components that were introduced in section 3.5, and introduce the term "Twelve Elementary Scenario Components" (ESC12).

For clarity and adequate understanding we will provide a definition of the term ESC12 that will be used frequently from this point onwards in this thesis.

Definition 4.1: ESC12

The ESC12 is the set of twelve Elementary Scenario Components that are the building blocks of each imaginable scenario. Every individual component of the ESC12 is characterised by meaning and by relation, and each component has a dynamic relation with other components. Since this relation is dynamic, it may happen that in some scenarios components have a null-relation.

In this chapter, we will propose to model criminal behaviour by using the ESC12. In section 4.1 we will focus on the relation between a criminal offence and a choreographed production. In section 4.2 we will describe the use of the ESC12 in modelling human behaviour. Section 4.3 provides a chapter summary.

4.1 A choreographed production

Literature suggests that both a theatrical performance and a criminal offence are choreographed productions, and that there is a strong analogy between the ways a theatrical performance and a criminal offence develop (see Karber, 1971; Sloan, 1981; Stohl, 1988; Weimann & Winn, 1994; Ayers, 2001; Tsfati & Weimann, 2002; De Graaff, 2007; Weimann, 2008). Based on this analogy, we will discuss that the elements that make up a scenario and those that make up a terrorist act, are correlated. Below we will describe how tools designed to create a theatrical production might offer valuable advantages in the anticipation of criminal behaviour.

The relationship between a creative scenario and a criminal offence has been studied in detail by renowned experts in the field of terrorism and that of theatre. The book *Simulating Terrrorism* (Sloan, 1981) describes the relation between scenario writing and terrorism. It suggests that terrorists follow the same path as scenario writers do: "An act of terrorism is like a theatrical performance. The terrorists write the scenario."

Stohl (1988) relates terrorism to a theatrical act: "Political terrorism is theatre. It is profound and often a tragic drama for which the world is the stage. Violence, death, intimidation, and fear are the theatrical ingredients. The plot often involves hostages, deadlines, and high-level bargaining. (…) But while the central ingredients are present in all forms of terrorism, as in the legitimate theatre, only certain plays are given prominent reviews and fewer still become hits. Likewise, only a few actors and directors achieve stardom."

De Poot et al. (2004) emphasise the relation between scenario writing and criminal investigation when they postulate: "Criminal investigation is about creating a story of a specific event. When all the components of a story can be connected, the story of a criminal offence is of sufficient quality to be handed over to the prosecutor" (De Poot et al., 2004).

In conjunction with Sloan and Stohl, Weimann (2008) compares terrorism to a choreographed production by stating: "Terrorism operates through symbolic expression, just as how dramaturgy works. From the theater-of-terror perspective, the September 11 attack on America was a perfectly choreographed production aimed at American and international audiences."

Based on the examples above, it may be argued that the connection between the art of scenario writing and committing a criminal offence or a terrorist act might not be as far fetched as may seem at first glance. Below, we will elaborate on the studies by Sloan (1981), Stohl (1988), McCue (2007), De Poot et al. (2004), and Weimann (2008), and propose to characterise and model criminal behaviour by the ESC12.

4.2 The twelve Elementary Scenario Components

In chapter three, we defined a scenario as a narrative describing foreseeable interactions between characters and the system. By definition, a scenario includes information about behaviour, goals, motivations, expectations, actions and reactions, successes and problems (see definition 3.1). In this section we will elaborate on the use of the ESC12 in modelling human behaviour in creative scenarios.

The art of creating and recounting scenarios plays a significant role in human existence. All over the world, from a young age, children are told narratives that introduce them to the realm of imagination. It prepares them to understand the world, its morals and ethics. These narratives are based on scenarios, just as history books, novels, films, and theatre plays are based on scenarios. Moreover, news-items are presented in the form of narrative (and quite literally based on scenarios), and much of our conversation is taken up by recounting every-day events in the form of scenarios (cf. Booker, 2004).

In popular perception, the variety of stories that are told throughout the world (and that have been told over the ages) is as infinite as the human imagination. However, as diverse as the stories might be, the scenarios on which the stories are built (a) follow a fixed pattern (see Booker, 2004) and (b) are based on elementary components. Box 4 presents an illustration of the universality of stories.

Box 4: The universality of stories

"Imagine we are about to be plunged into a story – any story in the world. A curtain rises on a stage, a cinema darkens. We turn to the first paragraph of a novel. A narrator utters the age-old formula 'once upon a time…'.
On the face of it, so limitless is the human imagination and so boundless the realm at the storyteller's command, we might think that literally anything could happen next. But in fact there are certain things we can be pretty sure we know about our story even before it begins."
(Booker, 2004)

The opening of *seven basic plots: why we tell stories* (Booker, 2004) cited above, effectively exposes the notion that a story is built around fixed components. In creative scenarios these components are effectively characterised by the ESC12.

These twelve Elementary Scenario Components are used to understand, explain, and model human behaviour. Table 4.1 lists the ESC12 together with a brief explanatory description.

	Component	Description
1	Arena	The location where the story takes place.
2	Time(frame)	The time(frame) in which the story takes place.
3	Context	The set of circumstances that surround the story.
4	Protagonist	The main character of the story around whom the plot evolves.
5	Antagonist	The opposition against whom/which the protagonist must contend.
6	Motivation	The psychological features that drive the protagonist.
7	Primary objective	The way by which the protagonist attains his motivation.
8	Means	The methods or instruments by which the protagonist achieves his primary objective.
9	Modus operandi	The method of operation of the protagonist.
10	Resistance	The obstacles the protagonist has to overcome to be able to achieve his objective.
11	Symbolism	It occurs when a component carries a symbolic value for the protagonist, antagonist, or the audience.
12	Red herring	A misleading occurrence or indicator used to lead someone in the wrong direction of thought.

Table 4.1 Description of the ESC12.

Emblematic for a creative scenario is the fact that a story is told from the perspective of the protagonist. The protagonist (from the Greek πρωταγωνιστής; "the one who plays the first part, the chief actor"[30]) is the central character in the series of events (cf. Booker, 2004; Lisle, 2010). More importantly, the ESC12 relate to one another in a series of events that move the protagonist and the story forward.

To appreciate creative scenario writing, one has to understand that the protagonist of the story does not necessarily have to be the "good guy". For instance, in *A clockwork orange* (Burgess, 1962) (adapted for film in 1971 by

[30] "protagonist"; Online etymology dictionary

Stanley Kubrick) a psychopathic delinquent named Alex is the protagonist of the story. Alex' pleasures are classical music, rape, and so-called "ultra-violence". In accordance with the "rules" of the creative scenario, the story is entirely told from Alex' perspective. The respectable writer Alexander -who is assaulted by Alex and his gang- consequently becomes one of the antagonists of the story. The relationship between the protagonist and the antagonist is an essential driving force of a scenario and the antagonist is as much responsible for the plot as the protagonist is. This has nothing to do with moral judgements or culpability, but everything with the relationship between the basic elements that are responsible for the development of a story or a crime.

Creative writing (as well as terrorism, as we argued in chapter two) may be regarded as a mode of communication. In subsection 2.3.2 we introduced a model that explained "terrorism as a form of communication". This model of communication emphasises the role of the audience as a separate entity. In harmony with this model, creative scenario writers regard the audience as a crucial but external part of the story. To orchestrate a story in such a fashion that it captivates and maintains the audience's interest, the ESC12 can be divided into three categories: (1) objective, (2) subjective, and (3) interpretable components. Below we briefly discuss these categories.

1 Objective components

Objective components constitute observable phenomena and are not related to the protagonist's individual feelings, imaginations, or interpretations. The objective components are *Arena*, *Time(frame)*, *Context*, *Protagonist*, *Antagonist*, *Means*, *Modus operandi*, and *Resistance*.

2 Subjective components

Subjective components, in contrast, pertain to the conception of the protagonist of the story. They reflect his individual interpretations of experiences consisting of emotional, intellectual, and spiritual perceptions as well as misperceptions. The subjective components are *Motivation* and *Primary objective*.

3 Interpretable components

Interpretable components are components that do not have a meaning until they are given an interpretation by a third party, i.e., the audience. The interpretable components are *Symbolism* and *Red herring*.

Table 4.2 lists the objective, subjective, and interpretable Elementary Scenario Components. In section 4.2.1 we will illustrate every individual scenario component by an example.

	ESC12	Objective	Subjective	Interpretable
1	Arena	X		
2	Time(frame)	X		
3	Context	X		
4	Protagonist	X		
5	Antagonist	X		
6	Motivation		X	
7	Primary objective		X	
8	Means	X		
9	Modus operandi	X		
10	Resistance	X		
11	Symbolism			X
12	Red herring			X

Table 4.2 ESC12: the objective, subjective, and interpretable components.

The order in which the ESC12 is presented within a scenario may vary from the order depicted in table 4.2. However, in a linear scenario, this is the most typical order for the ESC12 to be presented. For instance, the opening of the synopsis of *Apocalypse now* (Zoetrope, 1979) would read: "Saigon, 1973. It is the height of the war in Vietnam. U.S. Army Captain Willard is sent out a mission to locate renegade Colonel Kurtz who apparently went insane and now commands his own illegal guerrilla troop inside neutral Cambodia. Willard's objective is to terminate the colonels command…."

In the works of fiction that have been studied by the author of this thesis since 1990[31], the ESC12 appear to be presented, most commonly, in this sequential order. For that reason we will maintain the order of the ESC12 depicted in table 4.2 throughout our thesis.

In subsection 4.2.1 we will provide a brief explanation of the way the ESC12 are used in creative scenarios, by relating them to existing stories. In subsection 4.2.2 we will describe possible relations between *Symbolism*, *Red herring*, and the

[31] Ever since the compilation of the ESC12 in 1990, the author of this thesis has been challenging the Elementary Scenario Components by disparate narrative works of fiction such as films, books, theatre plays, and verbal stories from different cultural origin.

remaining Elementary Scenario Components. In subsection 4.2.3 we will relate the ESC12 to the "golden W's".

4.2.1 The ESC12 in a creative scenario

Below, we will provide two examples for studying the ESC12; (1) *The epic of Gilgamesh*, one of the earliest surviving written stories, and (2) the American blockbuster movie *Jaws*.

Example 1

The epic of Gilgamesh originates from Ancient Sumeria (modern Iraq), and was originally written on 12 clay tablets in cunieform script, between 2750 and 2500 BCE (Carnahan, 2001).

The epic of Gilgamesh centres on Gilgamesh, the King of Uruk, and his friend Enkidu. At the time the story takes place the kingdom of Uruk is threatened by a great and mysterious evil; a monster named "Humbaba the Terrible". In order to gain fame and renown, Gilgamesh proposes his friend Enkidu to go on a journey to the Cedar Forest to slay Humbaba. Gilgamesh is equipped with special weapons and, together with Enkidu, sets out on a long and hazardous journey to find the monster's lair. When they finally face Humbaba, Gilgamesh tricks the monster in letting his guard down and, after a fierce and titanic struggle, kills his evil opponent. The threat to the Kingdom of Uruk is eliminated and Enkidu and Gilgamesh return home as triumphant (cf. Carnahan, 2001; Booker, 2004).

The epic of Gilgamesh is a classic example of an "overcoming the monster" plot. It is one of only seven basic plots upon which stories can be built[32] (cf. Booker, 2004). The essence of the "Overcoming the monster" plot is rather simple. The protagonist of the story is made aware of the existence of some sort of superhuman embodiment of evil power. Be it in human shape (e.g., a giant or a witch), the form of an animal (e.g., a dragon or a shark), or in the shape of some sort of civilisation (e.g., an oppressing regime, or opposing belief), the monster is most often mortally dangerous. It represents everything which seems dark and sinister and is most inimical, threatening, and dangerous to the protagonist (and the audience) of a story (cf. Booker, 2004).

[32] According to Booker the seven basic plots are: Overcoming the monster, Rags to riches, The quest, Voyage and return, Comedy, Tragedy, and Rebirth (cf. Booker, 2004).

"Overcoming the monster" stories generally have such a profound symbolic significance that they transcend time and space. 4500 years after *The epic of Gilgamesh* was narrated in Ancient Sumeria, audiences in the Western world gathered to be terrified by the story of a giant man-eating shark that threatens Amity Island; which brings us to example 2.

Example 2

The 1975 blockbuster motion picture *Jaws* (Spielberg, 1975) is set in a small fictitious community that thrives on tourism during the summer season. The story precipitates when a monstrous man-eating shark named "Bruce" starts attacking offshore swimmers. Police chief Brody, determined to prevent more casualties, sets out with two companions to confront the shark. After a tremendous climatic fight, Bruce is finally slain. The threat to Amity Island has been lifted and the community comes together in universal jubilation (cf. Spielberg, 1975).

These two examples of "overcoming the monster" stories show that different narratives, separated by time and place, can be based on the same basic plot. Evidently, these examples are selected to illustrate adequately the twelve individual Elementary Scenario Components.

Illustrating the ESC12

The twelve Elementary Scenario Components were already briefly explained in section 3.5. To deepen the understanding of the ESC12, we will illustrate the significance of every individual scenario component by relating it to the examples mentioned above. In the descriptions that we give below, we do not aspire to analyse the two exemplified stories extensively. We merely aim to illustrate the role of the ESC12 in an adequate and effective manner.

1 *Arena*

The objective Elementary Scenario Component *Arena* refers to the physical location where an incident takes place. It may refer to a geographic location or a type of environment such as an urban or rural surrounding. For instance, in *The epic of Gilgamesh* the *Arena* of the story is The Kingdom of Uruk, while the story of *Jaws* unfolds within the confined space of Amity Island.

2 *Time(frame)*

The objective Elementary Scenario Component *Time(frame)* refers to the time or timeframe in which an incident takes place. For instance, a story can evolve within a timeframe of seconds as well as over a period of many years. In *The epic of Gilgamesh*, the timeframe is not noted (perhaps because some of the 12 tablets on which the story was written, were damaged). In *Jaws*, the timeframe is defined as "a summer season".

3 *Context*

The objective Elementary Scenario Component *Context* refers to the set of circumstances that surround the incident. It provides for actions to be appreciated within a social, cultural, or political background. In *The epic of Gilgamesh*, the *Context* is the threat that befalls the Kingdom of Uruk by a mysterious evil. In *Jaws*, the *Context* is the holiday season and the possible threat to the primary source of income of Amity Island; tourism.

4 *Protagonist*

The objective Elementary Scenario Component *Protagonist* refers to the main character in the scenario. According to the rules of creative scenarios, the plot revolves around the *Protagonist*, the central component within the ESC12. King Gilgamesh and police chief Martin Brody are examples of the *Protagonist* in the stories mentioned above.

5 *Antagonist*

The objective Elementary Scenario Component *Antagonist* represents the opposition against which the *Protagonist* must contend. The *Antagonist* in a scenario can be a person, a group of people, an institution, or a society, but also a situation, an animal, or an object. The monster Humbaba and the man-eating shark Bruce are examples of the *Antagonist* in the exemplified stories.

6 *Motivation*

The subjective Elementary Scenario Component *Motivation* refers to the psychological features that drive the *Protagonist* toward a desired goal. *Motivation* may be rooted in a basic impulse to optimise well-being, to minimize physical pain, or to maximize pleasure. *Motivation* generally can be classified into five categories: Need, Greed, Power, Moral outrage, and Glory (see subsection 2.2.3). Gilgamesh is driven by "fame and renown" (which may be classified as Glory). In addition, Police chief Brody may well be motivated by moral outrage after he is forced by the town's mayor (who fears that reports of a shark attack will ruin the summer tourist season) to attribute publicly the death to a boating accident, instead of a shark attack.

7 *Primary objective*

The subjective Elementary Scenario Component *Primary objective* refers to the primary objective of the *Protagonist*. It may be seen as a way by which the *Protagonist* attains his motivation. For instance, while the *Motivation* of Gilgamesh is classified as "Glory", the way to achieve that is to eliminate the threat to the Kingdom of Uruk and to return home as triumphant. The Elementary Scenario Component *Primary objective* is subjective in the sense that it is often not explicitly expressed, but rather related to the motivation of the *Protagonist*. For instance, when one would classify Brody's motivation as moral outrage, one could argue that Brody can only manifest his outrage by (i) determining the real cause of the death of the victim, and (ii) eliminating the man-eating shark.

8 *Means*

The objective Elementary Scenario Component *Means* refers to the method(s) or instrument(s) of the *Protagonist* to obtain a result or achieve an objective. *Means* in scenario writing generally is closely connected to the primary objective of the *Protagonist*. For instance, Gilgamesh is provided with special weapons that help him achieve his *Primary objective*. Similarly, Brody equips himself with shark-hunting equipment that helps him reach his *Primary objective*.

9 *Modus operandi*

The objective Elementary Scenario Component *Modus operandi* refers to the method of operation of the *Protagonist*. The *Modus operandi* often constitutes an elaborate set of manners employed by the *Protagonist*. This is the case in both the exemplified stories. For reasons of brevity, we will summarise for each exemplified story, one (strongly simplified) *Modus operandi*. In *The epic of Gilgamesh,* Gilgamesh tricks Humbaba to let his guard down by offering his sisters as concubine. This allows Gilgamesh the crucial advantage of surprise when he delivers the first blow. In *Jaws*, Brody kills the shark by shoving a pressurised scuba tank into its mouth. He subsequently shoots at the tank, causing it to explode.

10 *Resistance*

The objective Elementary Scenario Component *Resistance* refers to all the obstacles that the *Protagonist* has to overcome to attain his goal. In *The epic of Gilgamesh*, the *Protagonist* has to undertake “a long and hazardous journey” to be able to face Humbaba. In *Jaws*, police chief Brody first has to overcome the opposition of the town’s Mayor, who fears that reports of a shark attack will interfere with the town's primary source of income.

11 *Symbolism*

The interpretative Elementary Scenario Component *Symbolism* stands for one thing represented by another (by means of association, resemblance, or convention). *Symbolism* needs interpretation by (a member of) the audience. To put it in other words, *Symbolism* lies in the eye of the beholder. An interesting example of this is the Marxist *Symbolism* that Fidel Castro attached to the blockbuster film *Jaws*. In an interview with Coppola, Castro explains that the film symbolises “that businessmen are ready to sell out the safety of citizens rather than close down against the invasion of sharks” (Beekman, 2012).

12 *Red herring*

The interpretative Elementary Scenario Component *Red herring* can be regarded a false clue, designed to mislead the audience[33]. While we were not able to find a *Red herring* in *The epic of Gilgamesh*, the scenario of *Jaws* contains a prototypical false clue: When a large tiger shark is caught by fishermen, the townspeople (and more importantly the audience) are led to believe the problem has been solved. The beaches are re-opened and tourists are encouraged to go swimming again. It is only after Brody and a marine biologist secretly had opened the tiger shark's stomach and did not find any human remains that it becomes apparent that the threat to the tourists of Amity Island still exists.

[33] The figurative use of the term Red herring can be traced back to William Cobbett, who published a story in 1807 about how a Red herring was used to deflect hounds chasing after a hare. Cobbett used this story as a metaphor to decry the press, which had allowed itself to be misled by false information about a supposed defeat by Napoleon. This caused them to take off their attention from important domestic matters (Quinion, 2008).

4.2.2 The ESC12 in relation to the "Golden W's"

Insiders might have noticed that the ESC12 carry a remarkable resemblance with what is widely known as "the Golden W's" (Gross, 1908); a concept that, both in research and police investigations, is used for information gathering. Originally, the maxim of the Golden W's stems from classical rhetoric in which the relationships between separate elements can be found by obtaining arguments from various sources of information. The ancient rhetorician Hermagoras of Temnos (first century BCE) defined the following sources: *Quis, quid, quando, ubi, cur, quem ad modum, quibus adminiculis*. These sources can be translated as: Who is it about? What did happen? When did it take place? Where did it take place? Why did it happen? In what way did it happen? By what means did it happen?

The way information is connected in a criminal investigation carries a strong resemblance with the way information is connected in a scenario. The relationship between the Golden W's create a plausible scenario as well as a plausible ground for prosecution (see De Poot et al., 2004). In table 4.3 we have brought the components of the ESC12 in relation with the Golden W's.

	ESC12	**Golden W's**
1	Arena	Where did it take place?
2	Time(frame)	When did it take place?
3	Context	
4	Protagonist	Who is it about?
5	Antagonist	
6	Motivation	
7	Primary objective	Why did it happen?
8	Means	By what means did it happen?
9	Modus operandi	In what way did it happen?
10	Resistance	
11	Symbolism	
12	Red herring	
	(Plot)	What did happen?

Table 4.3 Comparison of ESC12 and Golden W's.

We note that six components of ESC12 are not included in the Golden W's. Four of the most obvious ones are: *Context*, *Antagonist*, *Motivation*, and *Resistance*. One might argue that these components do not seem to offer added value to the description of a criminal act. However, in our view, the *Context* of an incident is quintessential in the validation of information (cf. Van den Herik, 2007)[34]. Additionally, the *Antagonist* in a narrative carries a responsibility for the plot, just as a victim does in a violent crime. Moreover, the criminal theories highlighted in section 2.2 indicate that the components *Context*, *Primary objective*, *Motivation*, *Resistance*, and *Antagonist* are essential in the understanding of criminal behaviour. Therefore, it seems peculiar that exactly these components seem to be missing in the concept of "the Golden W's".

Next to the Elementary Scenario Components *Context*, *Antagonist, Motivation*, and *Resistance* two more components of the ESC12 are missing in the Golden W's, viz. *Symbolism*, and *Red herring*. These components effectively carry an added value in crime research. Appreciating the role of *Symbolism*, and *Red herring* in describing a criminal act might provide valuable insights into the predicaments of criminal behaviour. To illustrate the value of both these components, we have included a separate subsection 4.2.3 "*Symbolism* and *Red herring* in criminal behaviour".

One may note that "Plot" appears to be missing from the ESC12. Essentially and most simply put, a plot is what the characters do to deal with the situation they are in. It is a logical sequence of events that grows from an initial incident and alters the status (quo) of the characters (see George, 2004). In a narrative, the plot is the causal relation of the ESC12. For instance, in *Escape from Alcatraz* (Paramount Pictures, 1979), the *Arena* of the narrative explains the relation between the *Protagonists* (inmates that became befriended) and the *Antagonist* (the physical obstacles represented by the prison of Alcatraz, its guards, and -to a lesser extent- San Franscisco Bay). Also, the elaborate *Modus operandi*, which constitutes the use of spoons to dig through concrete walls as well as the fabrication of a *Red herring* (dummy heads created from a mixture of soap, paper, and real hair), has a causal relation to the limited *Means* the prisoners had. As the example of *Escape from Alcatraz* indicates, the plot is not an Elementary Scenario Component in itself but merely refers to the causal relation of the individual ESC12. Although the plot of a narrative is usually quite elaborate, we have compared the plot in figure 4.3, to the question "What did happen?"

[34] In chapter five we will argue that "context" is valuable in the process of turning information to knowledge. (See definition 5.1 and 5.2)

We like to remark that the fact that six Elementary Scenario Components are not included in the "Golden W's", does not suggest that they are likely to be ignored by investigators in an enquiry. It merely suggests that the critically acclaimed "Golden W's" may miss important components when used to model criminal behaviour. Consequently, the comparison between ESC12 and the "Golden W's" indicates that the ESC12 offer durable components to describe, characterise, and model a criminal act.

4.2.3 *Symbolism* and *Red herring* in criminal behaviour

Both the Elementary Scenario Component *Symbolism* and *Red herring* require additional explanation. These interpretable components do not exist within a creative scenario as autonomous components. *Symbolism* and *Red herring* are used in conjunction with other scenario components (see also subsection 4.2.1). To illustrate the value of the Elementary Scenario Components (1) *Symbolism* and (2) *Red herring* in criminal behaviour, we include two brief examples of these components in a terrorist incident.

1: *Symbolism* in a terrorist incident

In the attacks of September 11th 2001, the symbolic value of the targets (*Antagonists*) may have most likely been an important factor in the process of target selection. The World Trade towers were seen as a symbol for the financial and economic power while the Pentagon was regarded as a symbol for the military power of the USA.

2: *Red herring* in a terrorist incident

The videotape that was found after the bomb attack on Rafiq Hariri in Lebanon on February 14th 2005, suggested an Al Qaeda related Terrorist organisation was responsible for the attack. However, weeks later it turned out that the *Modus operandi* of the *Protagonist* had included a *Red herring* and no Al Qaeda related cell carried responsibility for the attack (cf. Mehlis, 2005).

As illustrated by the aforementioned examples, the Elementary Scenario Components *Modus operandi* or *Antagonist* may include a symbolic value or a *Red herring*. However, not every Elementary Scenario Component can be affected by these components.

To illustrate the possible relation between *Symbolism*, *Red herring*, and the remaining ten Elementary Scenario Components, we present table 4.3. An X indicates that a relation may exist.

	ESC12	**(11) *Symbolism***	**(12) *Red herring***
1	*Arena*	X	X
2	*Time(frame)*	X	X
3	*Context*		
4	*Protagonist*		X
5	*Antagonist*	X	X
6	*Motivation*		
7	*Primary objective*		
8	*Means*	X	X
9	*Modus operandi*	X	X
10	*Resistance*		

Table 4.4 The role of *Symbolism* and *Red herring*.

4.3 Chapter summary

In this chapter we argued that criminal behaviour may be characterised and modelled by the ESC12, a list of material components that are used to model human behaviour in creative scenarios.

First, we referred to research that studied the relation between terrorism and theatre. Based on this research[35], we support the claim that both a theatrical performance and a criminal offence are choreographed productions and that there is a strong analogy between the ways a theatrical performance and a criminal offence develop. Extending on this research, we propose a new way of modelling criminal behaviour that is based on the way human behaviour is modelled in creative scenario writing.

Second, we focussed our attention on the contents of the ESC12 components. We explained that the *Protagonist* is the central component of the ESC12 and that a scenario is created from the perspective of the *Protagonist*. Furthermore we related the role of the audience to a scenario, and explained that the ESC12 may be divided into three categories (viz. objective, subjective, and interpretable scenario components.).

[35] Earlier researchers who voiced similar a claim are: Karber, 1971; Sloan, 1981; Weimann & Winn, 1994; Ayers, 2001; Tsfati & Weimann, 2002; De Graaff, 2007; Weimann, 2008.

Third, to exemplify the universal shape of narratives that occurred over time and space, we introduced two examples of "overcoming the monster" scenarios. These examples were used to elaborate and illustrate the role of the twelve Elementary Scenario Components and their internal structure.

Fourth, we related the ESC12 to the "Golden W's", a concept that, both in research and police investigations, is used for information gathering.

Fifth, from the findings above, we may provisionally conclude that the ESC12 offer a durable set of components to describe, characterise, and model a criminal incident. Strengthened by this conclusion, we will proceed to design a new scenario model potentially able to anticipate criminal behaviour in the next chapter.

5

"The map is not the territory"[36]

Alfred Korzybski[37]

FIVE | Designing an ESC12 scenario model

This chapter constitutes the start of a new approach to anticipate crime. We will address the second research question of this thesis and propose a novel design for a scenario model able to anticipate criminal behaviour.

[36] The expression "the map is not the territory" first appeared in print in a paper by Alfred Korzybski at a meeting of the American Association for the Advancement of Science in New Orleans, Louisiana, December 28th 1931. Reprinted in *Science and Sanity*, 1933, pp. 747–61

[37] Alfred Korzybski (1879 - 1950), Polish-born American scientist and philosopher. Korzybski argued that many people do confuse maps with territories, that is, confuse models of reality with reality itself. With the dictum "the map is not the territory", Korzybski encapsulates his view that an abstraction derived from something, is not the thing itself.

While the area of criminal behaviour has been explored and described by researchers from different fields of expertise, we found no evidence that previous efforts attempted to map criminal behaviour with tools from scenario planning. As a result we cannot draw on previous knowledge in this field and will have to approach what lies ahead as "uncharted territory".

In this chapter we will address the second research of this thesis: *To what extent can a scenario model be designed by which criminal behaviour can be anticipated?* To this end we will document the design for a novel anticipative scenario model based on the ESC12 that were introduced in chapter three and defined in chapter four.

In section 5.1 we will study the process of data extraction using the quote by Alfred Korzybski above. Here we will introduce the graphics that will be used to explain the design of the ESC12 scenario model. In designing a new scenario model, we separate the conceptual design of the model, from the architectural design. The conceptual design encompasses the exploration of the concept of using ESC12 as a common denominator of the scenario model. This will be the subject of section 5.2. The architectural design encompasses the implementation of the modules that constitute the scenario model and their functional construction. This will be the subject of section 5.3. Conclusively, the results are discussed in section 5.4 in which we will answer RQ2.

As a guideline for the reader we will include a definition of the term ESC12 scenario model, which from this chapter onwards will be used frequently in this thesis.

Definition 5.1: ESC12 Scenario model

The ESC12 scenario model is an arrangement of modules and processes that accepts unstructured data as input, and presents structured scenarios as output. The data in the ESC12 scenario model is structured according to the ESC12, and the scenarios that are presented by the model, are constructed from the ESC12.

5.1 The territory and the map

In the previous section we mentioned that by designing a novel ESC12 scenario model, we are entering "uncharted territory". This approach hints at the analogy between the creation of a scenario model and that of a map. Both scenario modelling and cartography build on the premise that reality can be modelled so that future events can be anticipated. Creating a model means simplifying intricacies and eliminating irrelevancies without losing the essential components.

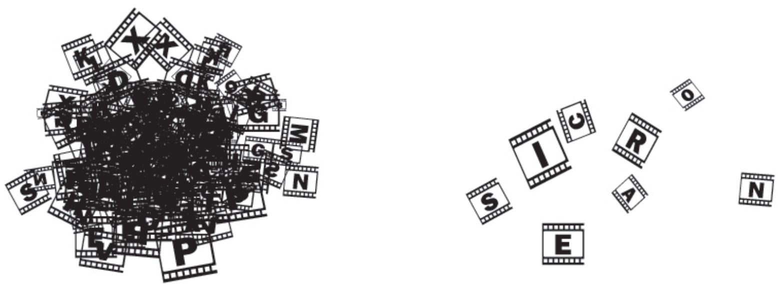


Fig 5.1a: the "territory"   Fig 5.1b: the "map"

Figure 5.1 Creating a map from a territory.

To clarify the relation between the territory and the map we created figure 5.1 in which a complex territory (figure 5.1a) is reduced to a map (figure 5.1b). The map retains data or information (or knowledge) that is relevant for a particular purpose.

In this thesis we refrain from a discussion on information and knowledge. For details on this topic we refer to Van den Herik (2007) and Vis (2012). As we will use both the terms "information" and "knowledge" in this thesis, we will provide two definitions relevant for our work. They are based on Van den Herik (2007).

Definition 5.2: Information

Information is data with a meaning.[38]

Definition 5.3: Knowledge

Knowledge is information within a context.[35]

[38] Combining definition 5.1 and 5.2, one may note that Knowledge is data with a meaning, within a context.

Below we will elaborate on (1) the territory, (2) the map, and (3) the difference between the two.

1 The territory

Figure 5.1a is to be considered as a representation of the complex territory of criminal behaviour, showing data that contains *all* the information related to a criminal incident. For instance, this data would include the social and professional connections that any of the people involved in a criminal act ever had with other individuals. It would also include information of the victims (and the people to whom they are related), the history of locations relevant to the incident, as well as tips from third parties, records of telephone conversations, and financial transactions made by any of the people involved. While the depicted territory contains all the crucial information for investigative purposes, the amount of data would clearly be too complex for analytic objectives[39]. It requires a process of extraction by which the essential components from the data collection are separated in such a way that the relationships between these components can be studied.

2 The map

In the example depicted in figure 5.1, the individual characters that make up the word "scenario" represent the essential components. Although these components were already present in the complex territory, they were hard to discern from the less relevant data.

Figure 5.1b can be regarded as a "map" that singles out the essential characters. The separation of the essential components of a crime allows for studying the relation between them. For instance, the specific size, orientation, or spatial distribution of the components can be studied and brought into relation with the complex territory of criminal behaviour.

[39] In this thesis we refrain from big data techniques. While big data has been around since the 1950's, the exponential growth of digital data in the past few years -and its expected acceleration in the next years- suggests big data techniques are still in their infancy. However, we predict a big future for narrative science and are convinced of the fact that the ESC12 will play a role in the techniques to be developed for narrative science.

3 "The map is not the territory"
The words by Korzybski at the beginning of this chapter reflect an essential concept. The map, by definition, is an abstraction of the territory. Just as the map should never be confused with the territory, models of reality should not be confused with reality itself. By definition, a model is less accurate than the territory it reflects. In fact, a perfect model (i.e., being accurate in all the original details) would be tragically ineffective. This paradox is based on the maxim that the more accurate a model is, the more it resembles the territory. Therefore, the most perfect model would be the territory itself. Such a model would obviously render itself perfectly useless.

The map is an important concept in the context of our thesis. In order to identify and separate the "essential components" of crime, we will have to go through a process of extraction comparable to that which cartographers execute. This process raises the possibility that information, vital for an investigation, may get lost in abstraction. To ensure that our findings and outcomes are evaluated with the appropriate level of caution, it is crucial to identify the danger of losing essential information in the process of abstraction as a potential shortcoming of our scenario model.

Our objective is to create a scenario model that allows human operators to navigate through the complex territory of criminal behaviour, in order to anticipate future incidents. Therefore, the scenario model requires a level of abstraction that maps out the essential components of criminal behaviour, yet does not reject relevant information. The scenarios that constitute the outcome of the model are to be appreciated as abstractions of the territory and will need to be "translated" to actual situations by domain experts in the field of criminal behaviour. Without this translation, the model is as useful as a map without somebody to relate it to the territory.

5.2 The conceptual design of the ESC12 scenario model

In this section, we focus on the conceptual design of a scenario model able to anticipate criminal behaviour. The conceptual design aims to give precedence to the *hypothetical function* of the model. Additionally, the conceptual design explores the value of modelling criminal behaviour by using the ESC12.

We will build the design of a novel scenario model on the research conducted in the previous chapters.

In chapter two, we listed the three critical elements that are responsible for the failure of military campaigns (cf. Cohen & Gooch, 1985).

1. The failure to learn (see definition 2.5)
2. The failure to adapt (see definition 2.6)
3. The failure to anticipate (see definition 2.7)

We argued that these three elements correlate with the domain of law-enforcement agencies in which (1) learning is required in the analysis of historic incidents, (2) adaptation is required in the process of investigation of a crime, and (3) anticipation is required in foreseeing (and adequately responding to) future criminal behaviour.

In chapter three, we studied the literature on scenario-based anticipation methods to value what previous research offered in the design of a novel scenario model. Based on this literature review, we defined a scenario model in chapter three as an arrangement of two or more scenarios that depicts how information about past scenarios (…) work in an interconnected way to generate an outcome with respect to possible future scenarios (see definition 3.2).

Moreover, in chapter three we stated that an effective scenario model should satisfy three conditions:

1. Offer the possibility to learn from historic criminal behaviour.
2. Offer the possibility to adapt the chosen strategy on the basis of indicators that are found.
3. Offer the possibility to anticipate (unexpected) future real-world behaviour.

In chapter four, we defined the ESC12 that include "information about behaviour, goals, motivations, expectations, actions and reactions, successes and problems" (see definition 3.3.2). We arrived at the provisional conclusion that the ESC12 may offer a durable set of components to describe, characterise, and model a criminal act.

In the design of a novel scenario model able to anticipate criminal behaviour, we take the information of the previous chapters as our point of departure.

To be able to explore the concept of the ESC12 in a conceptual design of the scenario model, we introduce a graphical representation that will guide us through this chapter. In this representation we restrict ourselves to an example set of letters, and portray the ESC12 as the components that are substantiated by elements of the following characters [S,C,E,N,A,R,I,O]. When put in the right order, they form the word SCENARIO.

To each of the characters, three discernable features are related, viz.

1. Orientation: characters with identical orientation are part of the same historic scenario,
2. Size: the size of a character reflects its importance within a scenario,
3. Spatial distribution: the distance between individual characters of a scenario reflects the strength of their relation.

The aforementioned features will be used to clarify the conceptual design of the ESC12 scenario model. We will explain how storing the ESC12 components in a structured way, may be used for (1) the ability to learn (subsection 5.2.1), (2) the ability to adapt (subsection 5.2.2), and (3) the ability to anticipate (subsection 5.2.3).

5.2.1 ESC12 and the ability to learn

In chapter two we have defined *learning* as the ability to absorb readily accessible lessons from history. Traditional law enforcement does not value lessons from history mainly because history is not stored in a way that makes it readily accessible (cf. McCue, 2007). Criminal incidents are investigated as separate events; as individual scenarios that are not brought into relation with previous criminal incidents. According to McCue (2007) law-enforcement agencies regard a criminal incident as a unique event that consists of a set of specific, idiosyncratic characteristics. However, as she argues, analysis of similar historic incidents may offer an important added value. Therefore, to enable researchers to absorb readily accessible lessons from history, the conceptual design of the ESC12 scenario model has to provide the ability to compare and contrast different criminal incidents.

Our point of departure in the conceptual design is the process of pre-processing. This process relies on a breakdown of historical data in the Elementary Scenario Components (i.e., the ESC12). To clarify the process of pre-processing, figure 5.2 is drawn in which figure 5.2a represents *all* the available and heterogeneous raw data related to criminal behaviour. Figure 5.2b represents the extracted ESC12 related to *one specific incident*.

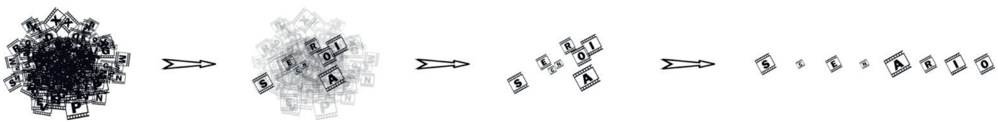


Fig 5.2a The heterogeneous data. Fig 5.2b The ESC12.
Figure 5.2 Extracting the ESC12 from the heterogeneous dataset.

Pre-processing data into the ESC12 provides "building blocks" by which classification, ranking, and combination of individual Elementary Scenario Components is made possible. Extracting these components from the raw dataset is an essential part of the scenario model, as the ESC12 will provide the common denominator that facilitates the flow of information between the different stages of the scenario model.

Additionally, pre-processing raw data into the ESC12 allows criminal incidents to be described in a structured and systematic manner. It facilitates (1) the analysis of individual scenarios, (2) the analysis of multiple, idiosyncratic scenarios, and (3) the analysis of idiosyncratic ESC12. Below we will briefly describe these three types of analysis.

1 Analysis of individual scenarios

Having identified the ESC12 related to a specific incident (as depicted above), their size and spatial distribution can be analysed in an attempt to discover meaningful relations.

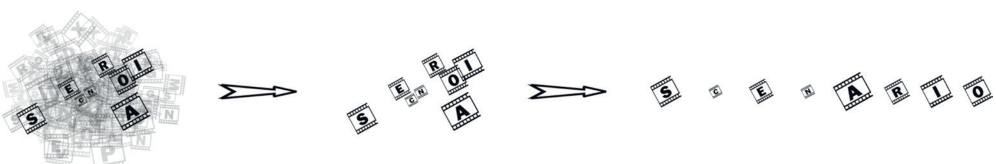


Figure 5.3 Extracting an individual scenario from the dataset.

For example, based on figure 5.3, one may note that the characters “E” and “R” have the same size, or that “A” is the largest character of all.

These observations might reveal meaningful relations that are relevant in this specific scenario. However, they might also prove to be useful in discovering meaningful relations that transcend the level of individual criminal incidents.

2 Analysis of multiple, idiosyncratic scenarios

While an individual scenario may be analysed for the size and spatial distribution of its particular ESC12, comparing these observations to other scenarios may offer an added value. Figure 5.4 depicts the extraction of three separate scenarios from the dataset.

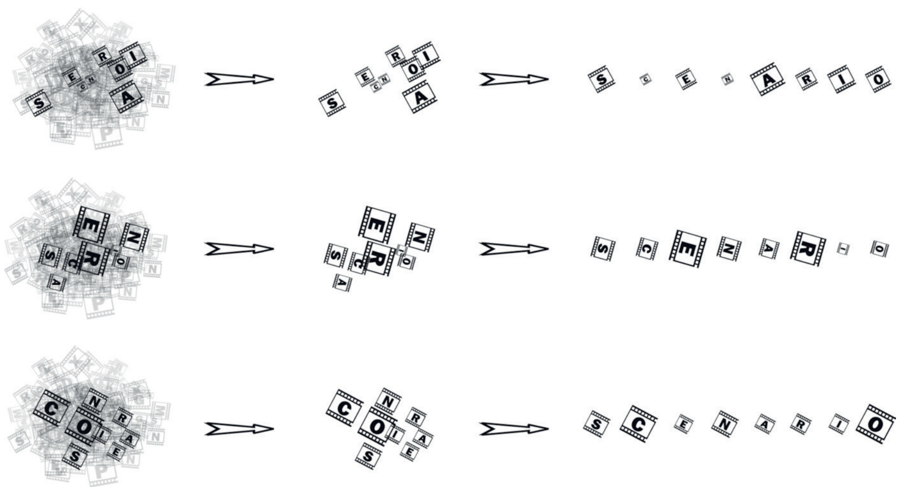


Figure 5.4 Extracting multiple scenarios from the dataset.

Studying the size and spatial distribution of the ESC12 in the three different scenarios may render new relations about the way the ESC12 are related. These new relations may (dis)prove earlier ones. For instance, from the three scenarios depicted in figure 5.4 one may conclude that the size of the characters “E” and “R” are the same within each individual scenario (which confirms the relation that was discovered in the aforementioned analysis of the individual scenario). Moreover, analysis of the three scenarios reveals that the characters “S” in all three scenarios have the same size. Additionally, one could note that concerning the spatial distribution of the characters, the two letters “I” and “O” show an overlap in all three scenarios.

3 Analysis of idiosyncratic ESC12

Accumulating the ESC12, identified from different incidents, in a systemised way will create a "scenario matrix", or a two-dimensional array of Elementary Scenario Components, arranged in rows and columns. This is depicted in figure 5.5.

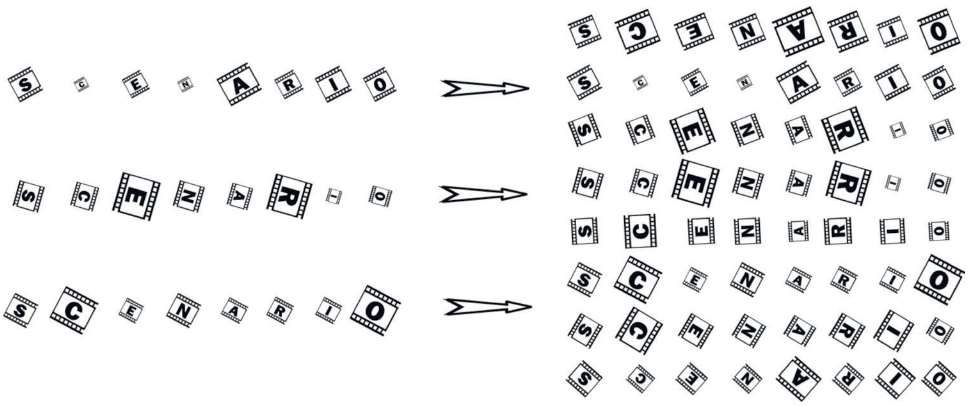
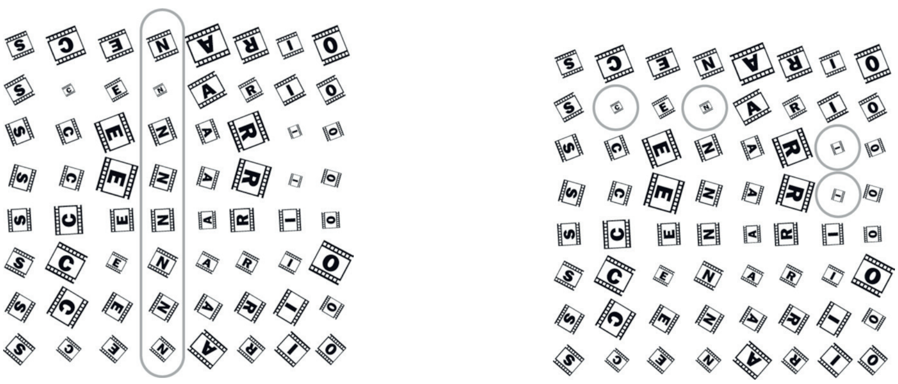


Figure 5.5 Creating a two-dimensional scenario matrix.

Storing the ESC12 in a structured way creates a new perspective on the data. For instance, it allows for comparing Elementary Scenario Components from incidents that are seemingly not related. An example is given in figure 5.6a, where the letters N from different scenarios are compared with each other.

Additionally, it allows for analysing the Elementary Scenario Components that appear to have the same size. In figure 5.6b the letters that appear to have the same size can be compared with each other.



5.6a Analysis of one ESC12.

5.6b Analysis of same-sized ESC12.

Figure 5.6 The ability to learn.

As the aforementioned examples indicate, the process of pre-processing historical data in ESC12 and storing these components in a systemised manner, might unveil meaningful findings about the way data is related that could not have been found by traditional analysis of individual scenarios.

Referring to our definition of *information* (see definition 5.1), we may state that the discovery of relations in crime-related data gives meaning to that data. This *meaning* essentially provides information, which subsequently becomes *knowledge* when it is put into the context of criminal behaviour (see definition 5.2). This process is quite valuable, both in predictive analysis as well as in intelligence.

5.2.2 ESC12 and the ability to adapt

In chapter two, we have defined *adapting* as the ability to take appropriate action to deal with new and unexpected situations. A scenario model that breaks down incidents in ESC12 may be of significant importance in the process of adapting to (and taking appropriate action to deal with) developing criminal behaviour. For instance, when an incident has recently occurred, historic scenarios can be studied for similarities to the present incident, suggesting or prioritising areas of investigation. Below we provide an example. To illustrate the process of adaptation, we created figure 5.7.

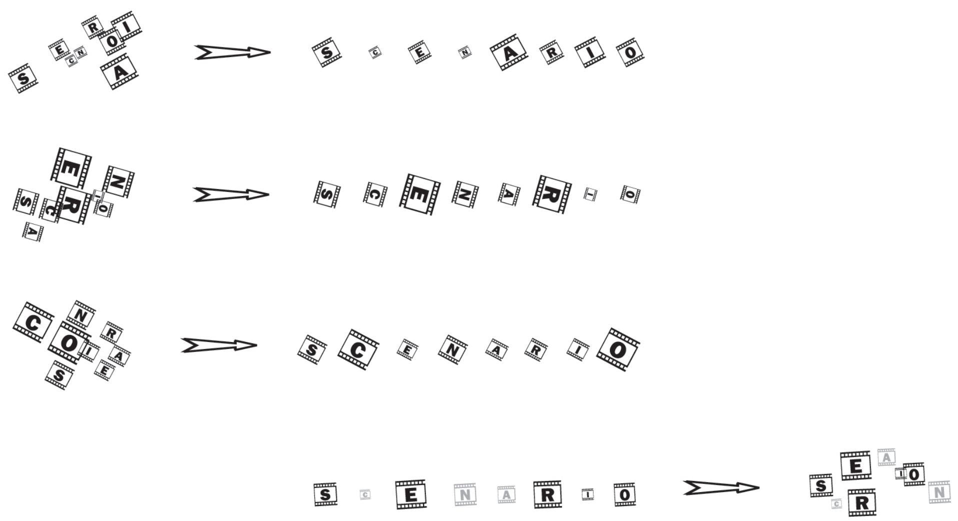


Figure 5.7 The ability to adapt.

The scenarios depicted on the top three rows of figure 5.7 were taken from the examples described in subsection 5.2.1. Analysis of these scenarios revealed three meaningful relations.

1. The size of the characters "E" and "R" are the same within each of the individual scenarios
2. The characters "S" have the same size in the three scenarios.
3. In the three scenarios the characters "I" and "O" overlap (see subsection 5.2.1).

In box 5 we have translated these relations to an operational law-enforcement illustration.

Box 5: A practical illustration

If we were to translate the three relations mentioned above to an operational law-enforcement situation, the analysed scenarios may indicate that

1. in the three incidents different types of weapons (*Means*) were used, these weapons, correlate with the *Resistance* the protagonist had to overcome;
2. the *Motivation* for executing the incident in all three scenarios was the same;
3. the *Arena* in which the antagonist was killed, correlates strongly with *Symbolism*.

Based on (a) the scenarios on the top three rows of figure 5.7 and (b) the relations they reveal, the scenario on the fourth row might be generated. Comparing this scenario to (the scenario of) the incident that recently occurred, might disclose unexpected similarities, suggesting or prioritising areas of investigation[40].

5.2.3 ESC12 and the ability to anticipate

In chapter two, we have defined "anticipating" as the ability to foresee and adjust in a timely and effective fashion to future challenges. Anticipation in this context encompasses the analysis of current and historical facts to make predictions about future events. It relies on meaningful relationships, captured from past occurrences, to predict future trends and behaviour (see Fayyad, Piatetsky-Shapiro, & Smyth, 1996).

[40] Notably, the newly generated scenario (fourth row of figure 5.7) may be added to the scenario matrix, augmenting the dataset beyond cases that took place in the past and extending it to possible future scenarios.

In figure 5.8 the character "E" represents an essential component of a criminal incident. Given this character, the ambition could be to predict the size, orientation, and spatial distribution of missing characters related to this scenario. Having extracted useful relations between the ESC12 in subsection 5.2.1 (viz. (1) size of the characters "E" and "R" are the same within each individual scenario, and (2) the characters "S" in all three scenarios have the same size), and applying these relations to the given character "E", shows that this is achievable as figure 5.8 depicts.

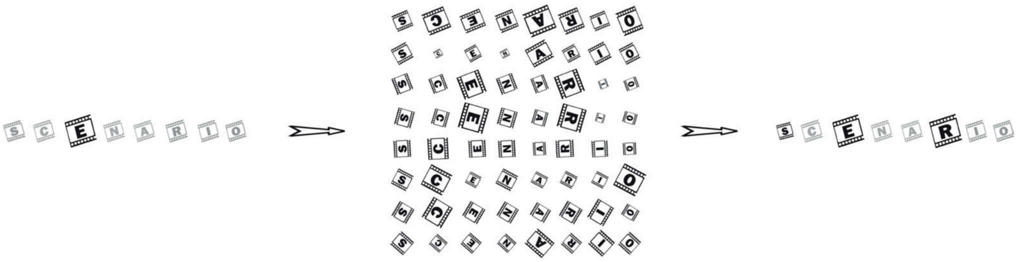


Figure 5.8 The ability to anticipate.

The process of anticipation may be exploited to generate actionable output in a law-enforcement context. In *Data mining and predictive analysis*, McCue (2007) describes this process in drug-related homicide. By analysing data from historical incidents, a useful relationship was determined between the residence of victims and their subsequent murder location. Based on this "meaningful" relation, analysts were able to predict the likely location of an incident that was about to take place. Implementing this relation, the behaviour patterns of the potential victim could be modelled and used to anticipate the nature of future events (see McCue, 2007).

5.2.4 Formalisation of the conceptual design

In this section we will present a formalisation of the principles of the conceptual design that were explained above.

Formally, we can refer to a historic scenario as p. As we have argued, every scenario consists of the same set of Elementary Scenario Components. We will refer to the ESC12 of scenario p as x_1 to x_{12}. (In the aforementioned figures we have limited x_1 to x_n to the 8 characters of the word scenario). Consequently, the historic scenario p may be denoted as follows.

$$p(x_i) \text{ in which } i = [1..12]$$

Assume that p is not one historic scenario but a collection of historic scenarios. Each scenario of the collection may be denoted as p_j in which j = 1 to m, and m refers to the total amount of different scenarios in the collection. (In the aforementioned illustrations we have represented this collection of historic scenarios as the rows of the scenario matrix. See figure 5.5). Consequently, a collection of historic scenarios may formally be denoted as follows.

$$p_j(x_i) \text{ in which } j = [1..m] \text{ and } i = [1..12]$$

Assume that the scenario q refers to a new or future incident, which evidently comprises the same set of Elementary Scenario Components, which we will denote as y_1 to y_{12}. Consequently, the new scenario q may be described as follows.

$$q(y_i) \text{ in which } i = [1..12]$$

So far, we represented one Elementary Scenario Component for a scenario by $p_j(x_i)$. The next step is to evaluate the Elementary Scenario Component x_i under the scenario p_j (In the aforementioned illustrations we have given value to orientation, size, and distribution). This can be done by evaluating the function E. So, we then arrive at

$$E(p_j(x_i)) \text{ in which E denotes the function Evaluate}$$

Instead of evaluating one Elementary Scenario Component x_i under a scenario p_j, we can also evaluate all Elementary Scenario Components under the scenario p_j. This leads to

$$E_A\,(p_j(x)) \text{ in which } E_A \text{ denotes the function Evaluate all, and x means } (x_1, x_2, \ldots x_{12})$$

An interesting question can be posed on the relation between

$$E_A\,(p_j(x)) \text{ and } \sum_{i=1}^{n} E\,(p_j(x_i))$$

as well as the relation between

$$E_A\,(p_j(x)) \text{ and } \sum_{j=1}^{m} \sum_{i=1}^{n} E\,(p_j(x_i))$$

Here, we remark that the investigations involved are beyond our research topic.

Below, we briefly discuss the plain application of the formalisation for (1) the ability to learn, (2) the ability to adapt, and (3) the ability to anticipate below.

1: The ability to learn

The ability to learn as described in subsection 5.2.1 refers to (1) the analysis of individual scenarios, (2) the analysis of multiple, idiosyncratic scenarios, and (3) the analysis of idiosyncratic ESC12. The formal description of the individual scenarios is fairly straightforward: $p(x_i)$ in which i = [1..12]. The formal description of the analysis of multiple, idiosyncratic scenarios is the next step. It refers to the analysis of $p_j(x_i)$ in which j = [1..m] and i = [1..12]. For instance, one could analyse any i=1..12 of the components x_i of the scenarios p_j present in the collection p (as depicted in figure 5.6a), or one could analyse the sets of equal values x_i of every i=1..12 of the scenarios p_j present in the collection p (as depicted in figure 5.6b).

2: The ability to adapt

The ability to adapt as described in subsection 5.2.2 refers to the situation in which appropriate action is required to an actual situation. In this case, historic scenarios may be studied for similarities to the present (unfolding) scenario, called g.

To measure the similarity between (the Elementary Scenario Components of) two scenarios, one could, for instance, analyse the Euclidean distance (i.e., the "ordinary" distance) between two points, provided that measurement rules have been designed and applied. Moreover, in that case, one might measure the cosine of the angle between two vectors $p_j(x_i)$ and $q(y_i)$ with j = 1..m and i=1..12. Subsequently, a new area of research is to be developed.

3: The ability to anticipate

The ability to learn as described in subsection 5.2.3 is based on analysing the scenario collection p for similar values for their respective ESC12. When a new scenario arises (i.e., when an incident recently took place), a number of ESC12 may be known, while the remaining Elementary Scenario Components remain unknown. In such a new case, we may identify the Elementary Scenario Components of historic scenarios p, that resemble the new scenario q, by selecting the scenarios p_j in which d(x,y) is minimal. In the scenarios p_j, we may use the Elementary Scenario

Components that appear in x and not in y, to anticipate scenario q by the following rule.

Find all $p_j(x)$ for a given y in which $d(x,y) < r$, with r being the threshold[41]

Moreover, we may use the Elementary Scenario Components x that appear frequently in the historic scenarios p_j, to anticipate the current scenario q by the following rule.

Of all retrieved $p_j(x)$ determine per Elementary Scenario Components x_i, which values appear frequent.

We reiterate here that many interesting questions emerging from the formalisation are not discussed in this thesis as we focus on a first implementation of ideas and not on the development and implementation of an extended formal framework.

5.3 The architectural design

Anticipating future events on the basis of historical incidents requires studying large sets of complex data as well as elaborate knowledge about the world (see McCue, 2007). In order to anticipate future events, and to produce operationally actionable output in a law-enforcement context, the ESC12 scenario model must be able to process large sets of complex data. The architectural design of the ESC12 scenario model therefore needs to encompass a configuration of modules that facilitate specific processes. For clarity and adequate understanding we will provide definitions for both the terms *module* and *process* below.

Definition 5.4: Module

A module is a structural component of the ESC12 scenario model that (i) accommodates the infrastructure for a process to be performed, and (ii) controls the process.

Definition 5.5: Process

A process is a series of actions, changes, or functions bringing about a result.

[41] In this example, a relative high threshold r would result in more recall, while a relative low threshold r would amount to more precision.

Based on the conceptual design discussed in the previous section, we arrived at an architectural design that encompasses four modules facilitating six processes. For convenient reading, we separate the modules from the processes by italicising the latter.

The four modules of the scenario model are
(1) Data cruncher
(2) Scenario matrix
(3) Controller
(4) Scenario generator

The six processes are
(A) Data pre-processing
(B) Data warehousing
(C) Facilitating differentiated output
(D) Generating differentiated output
(E) Feedback
(F) Applying knowledge

As we will discuss below, four of the processes are accommodated by a single module (viz. the process of *Data pre-processing* is accommodated by the module Data cruncher, the process of *Data warehousing* is accommodated by the module Scenario matrix, the process of *Facilitating differentiated output* is accommodated by the module Controller, and the process of *Generating differentiated output* is accommodated by the module Scenario generator.). Both the remaining two processes (viz. *Feedback* and *Applying knowledge*) are accommodated by two modules (viz. Scenario matrix and Scenario generator).

Below we will elaborate on the architectural design in detail. For convenient reading, we include table 5.9 that indicates the subsections (5.3.2 to 5.3.6) in which we will discuss the four modules (indicated by the numbers 1 to 4) and the six processes (indicated by the letters A to F). Combining the four modules and six processes, we will provide a blueprint of the architectural design in subsection 5.3.7.

Subsections	Four modules				Six processes					
	1	2	3	4	*A*	*B*	*C*	*D*	*E*	*F*
5.3.2	x				x					
5.3.3		x				x				
5.3.4			x				x			
5.3.5				x				x		
5.3.6									x	x

Table 5.9 The four modules and six processes.

For adequate understanding, we include figures in the subsections 5.3.2, 5.3.3, and 5.3.5 that were introduced in the discussion of the conceptual design in section 5.2. Moreover, we frequently refer to figure 5.13 in which the four modules and six processes are brought together in the blueprint of the design of architectural model.

5.3.1 The dataset

The dataset essentially is an external part of the scenario model. It is therefore not labelled as one of the components of the model. However, the ESC12 scenario model is not able to operate without a specific dataset. Moreover, the model needs to be able to accommodate different sets of criminal incidents (e.g., data on lethal criminal violence, gang related data, etc.).

As argued by McCue (2007) a dataset of historical criminal incidents is "generally very large, heterogeneous, often incongruous in nature and includes unsystematic and incomplete data". To be made usable in the ESC12 scenario model, data needs to be crunched into components which the model can process. For this purpose the first module is created.

5.3.2 Module 1: Data cruncher

Describing criminal incidents in such a way that information becomes readily available as well as operational for its use in law enforcement requires that the heterogeneous data of historical criminal incidents is broken down into homogeneous components that the model can process. For this purpose the module Data cruncher is designed.

Figure 5.10 is a graphical representation of the Data cruncher. It represents the heterogeneous data of historical criminal incidents (see subsection 5.3.1) on the left side of the figure, and the relevant Elementary Scenario Components of three separate incidents on the right side of the figure.

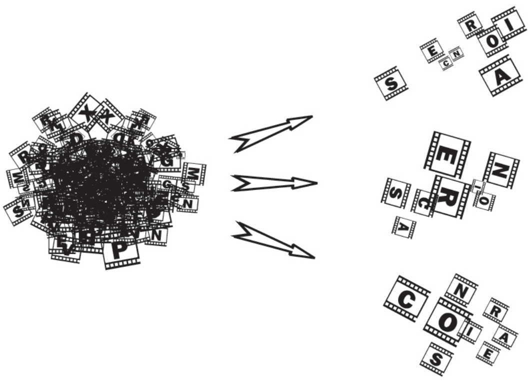


Figure 5.10 The Data cruncher.

Effectively, the Data cruncher extracts the Elementary Scenario Components from the large and heterogeneous dataset that is in use by law-enforcement agencies. As such, the first module controls the process of *Data pre-processing*.

Process A: *Data pre-processing*
The process of *Data pre-processing* refers to the extraction of the ESC12 from the dataset. *Data pre-processing* is an essential part of the scenario model as the ESC12 provide the common denominator that facilitates the flow of information between the different stages of the scenario model.

In chapter six the process of *Data pre-processing* will be explained more in detail. To appreciate the role of the Data cruncher in the architectural design of the ESC12 model, it is sufficient to understand that the Data cruncher serves the process of *Data pre-processing* and extracts the relevant data of a criminal act from the dataset.

5.3.3 Module 2: Scenario matrix

Once the ESC12 are extracted from the dataset, the separate Elementary Scenario Components may be introduced into the Scenario matrix, where they are stored by category. From this point onwards the scenario model includes homogeneous data that is consistently coded, grouped in several tables, and positioned in a relational grid. Figure 5.11 is a graphical representation of the scenario matrix. It represents the data of several criminal incidents (depicted in rows), categorically stored in a consistent format.

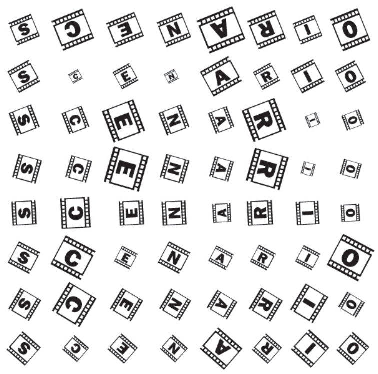


Figure 5.11 The Scenario matrix.

The module Scenario matrix is designed to store data in such a fashion that it becomes readily available for analysis. Effectively, this second module of the architectural design facilitates the process of *Data warehousing*.

Process B: *Data warehousing*

The process of *Data warehousing* offers four advantages.

1. The storage of data in a consistent format allows for rapid comparison of individual historic scenarios.
2. In warehousing the data, the Scenario matrix stores knowledge about the way data is related (i.e., the relation between the ESC12 within an specific scenario).
3. Warehousing the data in the ESC12 format preserves the data history, which permits studying the disassembled ESC12 for new and unforeseen correlations, without losing the relation they have with the original context (i.e., the original scenario).
4. The process of warehousing the data stored by category, allows for (i) complex queries, and (ii) the retrieval of information (or meaningful data) from the dataset. For instance, from the data in the Scenario matrix, information on the development of different organisations can be retrieved (such as information on the evolution of *Modi operandi* over a certain time period).

5.3.4 Module 3: Controller

The Controller in the scenario model is a required interface that receives user input and initiates a response by making calls for data or information in the Scenario matrix. The Controller module essentially links the user to the ESC12 scenario model and is responsible for the process of facilitating differentiated output.

Process C: *Facilitating differentiated output*

The process of *Facilitating differentiated output* is the process by which commands are issued to the scenario matrix, and an output is commissioned based on the users' request.

5.3.5 Module 4: Scenario generator

The Scenario generator is instructed by the Controller and represents the module that is responsible for delivering the final product of the ESC12 scenario model. Based on the users' request, the output of the Scenario generator can be presented in a variety of formats as will be discussed below in the process of *Generating differentiated output*. Figure 5.12 is a graphical representation of the Scenario generator and the variety of output that it can produce.

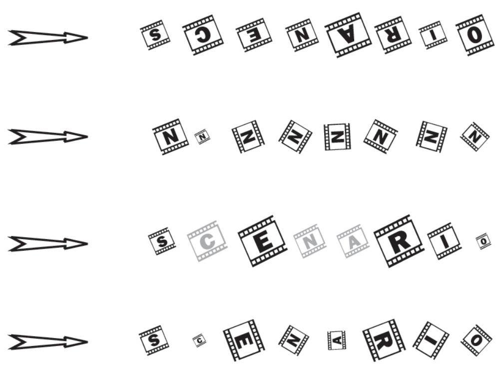


Figure 5.12 The Scenario generator.

Module 4 of the architectural design of the ESC12 scenario model executes the process of *Generating differentiated output*.

Process D: *Generating differentiated output*

The process of *Generating differentiated output* refers to the output, different in form and nature, which the ESC12 scenario model generates. Based on the users' request, the ESC12 scenario model has to be able to produce an output in the form of an ESC12 scenario.

For instance, the first row of figure 5.12, represents the output related to an incident that actually occurred in the past[42]. Additionally, the fourth row of figure 5.12 represents a scenario that has no manifest relation to a situation that actually occurred, but is constructed from a combination of ESC12 related to different incidents[43]. The third row of figure 5.12 refers to a situation in which, at a certain point in time, four components of an incident are known (represented by the characters S,E,R, and I), and the ESC12 scenario model is requested to suggest options for the remaining components[44]. All these three outputs are presented in the form of a scenario (of different nature) that consists of a collection of Elementary Scenario Components. However, the Scenario generator may also present output in a different form as is illustrated by the second row of figure 5.12. This row represents the outcome of a request to compare one single Elementary Scenario Component between different individual scenarios.

As diverse as the output can be, the product of the Scenario generator will be based on the ESC12. Proposing an output that is formatted in congruence with the way information is stored in the Scenario matrix, offers advantages both in the process of *Feedback* as in the process of *Applying knowledge* that are described below.

5.3.6 *Feedback* and *Applying knowledge*

Feedback and *Applying knowledge* are two processes that are not connected to one single module of the scenario model. Both these processes take place in between the modules Scenario matrix and Scenario generator (see figure 5.13). While the Controller bridges these two modules, the output that is generated by the scenario model may flow back from the Scenario generator into the Scenario matrix, either by the process of *Feedback* or by the process of *Applying knowledge*.

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[42] Note that the orientation of the separate ESC12 in this scenario is the same.

[43] Note that the orientation of the separate ESC12 in this scenario is different.

[44] Note that the known components S,E,R, and I, in this scenario are presented in black, and that the components suggested by the ESC12 scenario model, appear in grey.

Process E: *Feedback*

As argued above, the output of the scenario model is presented in ESC12 format (i.e., in the form of scenarios that constitute a combination of the ESC12 components). This format allows for a seamless introduction of the outputted scenario back into the Scenario matrix to accumulate the number of scenarios present in the matrix (see figure 5.13). The process of introducing newly generated scenarios into the ESC12 scenario model is defined as the process of *Feedback*.

Process F: *Applying knowledge*

The process of Applying knowledge refers to exploiting knowledge (i.e., data with a meaning and information, within a context (see definition 5.2)) that is latently present within the ESC12 scenario model. For instance, when the analysis of historic scenarios produces additional, and previously unknown knowledge, this knowledge may be fed back into the system (see figure 5.13). The process of introducing newly ascertained knowledge into the ESC12 scenario model is defined as the process of *Applying knowledge*.

In essence, the processes of *Feedback*, and that of *Applying knowledge*, provide for a scenario model that is in a continuous state of learning, augmenting the data, the information, and the knowledge.

5.3.7 The blueprint

Combining the modules and processes described above leads to an outline of an ESC12 scenario model by which criminal behaviour may be anticipated. To illustrate this outline, we create figure 5.13 which can be seen as a blueprint, a graphical representation documenting the architectural design of the ESC12 scenario model. The blueprint integrates and synthesises the four modules (viz. Data cruncher, Scenario matrix, Controller, and Scenario generator) and six processes (viz. *Data pre-processing*, *Data warehousing*, *Facilitating differentiated output*, *Generating differentiated output*, *Feedback* and *Applying knowledge*) into the architectural design of an ESC12 scenario model able to anticipate criminal behaviour.

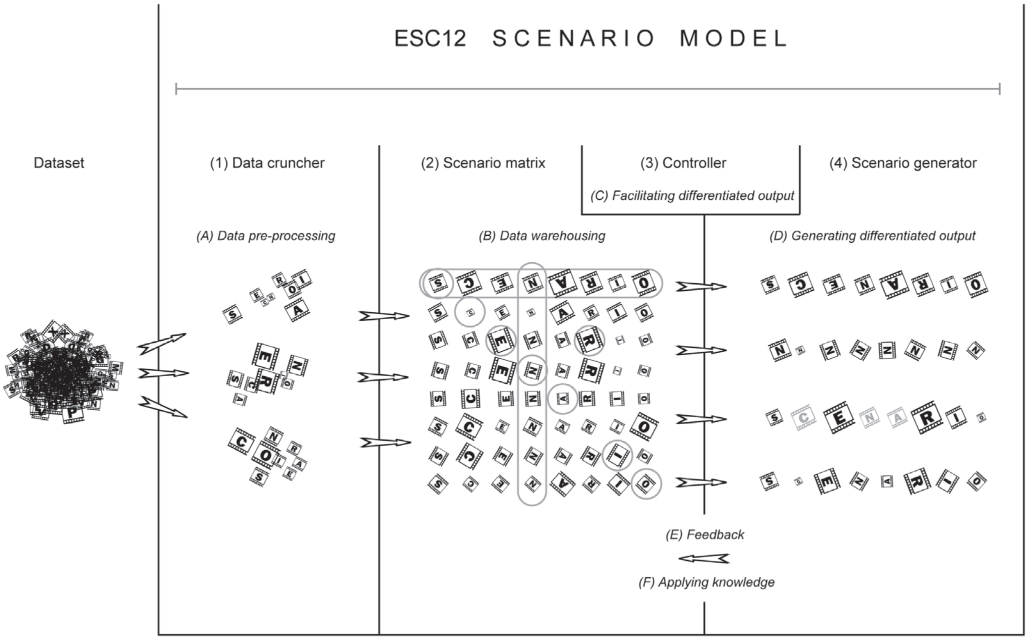


Figure 5.13 The blueprint of the ESC12 scenario model.

5.4 Answer to research question 2

In this chapter we addressed the second research question of our thesis [*To what extent can a scenario model be designed by which criminal behaviour can be anticipated?*]. To address this RQ, we documented the conceptual and architectural design of a novel scenario model that allows human operators to anticipate future criminal behaviour.

The design parameters of the scenario model are based on the research conducted in the previous four chapters. We synthesised information from the theoretical basis of our thesis (chapter two), with the literature review (chapter three), and our study of the ESC12 (chapter four) into a definition of an ESC12 scenario model. Moreover, we ascertained that an effective scenario model facilitates (a) the storing of knowledge and experience gained from previous situations, which will be used for (b) detecting and analysing trends and unexpected relations. Successively, these trends and relations are to be extrapolated towards the future to (c) assist in anticipating future incidents.

Subsequently, we separated the *conceptual design* (in which the hypothetical function of the model is explored), from the *architectural design* (in which the modules and processes that constitute the model are studied).

To guide the process of *conceptual design*, we defined three factors that are deemed quintessential in military and law-enforcement campaigns; the ability to learn, the ability to adapt, and the ability to anticipate (Cohen & Gooch, 1985). As we determined, the ESC12 scenario model needs to contribute to these abilities in order to be effective in law-enforcement context. With specially designed graphics we explored the role of the ESC12 in the scenario model. To answer RQ2 we investigated whether ESC12 offers a durable set of components that enables (a) learning from criminal behaviour, (b) adapting to developing criminal behaviour, and (c) anticipating future criminal behaviour.

Our exploration of the conceptual design of the ESC12 scenario model served as the foundation for the *architectural design* in which we studied the modules and processes that would amount to a scenario model able to anticipate criminal behaviour. We integrated four modules (viz. Data cruncher, Scenario matrix, Controller, and Scenario generator) and six processes (viz *Data pre-processing*, *Data warehousing*, *Facilitating differentiated output*, *Generating differentiated output*, *Feedback* and *Applying knowledge*) into a proposal for an architectural design of an ESC12 scenario model. The resultant design has been presented in the form of a blueprint, a graphical representation of the architectural design of the ESC12 scenario model.

Effectively, this blueprint constitutes the answer RQ2. By this constructive approach we have made plausible that an ESC12 scenario model can be created to the extent that it is in principle able to combine observations and indications in a classified way, which may lead to a realistic scenario of a criminal act.

To assess the actual potential of the ESC12 scenario model to anticipate criminal behaviour, we will combine the design proposed in this chapter with an actual dataset of criminal behaviour. This will be the subject of the next chapter.

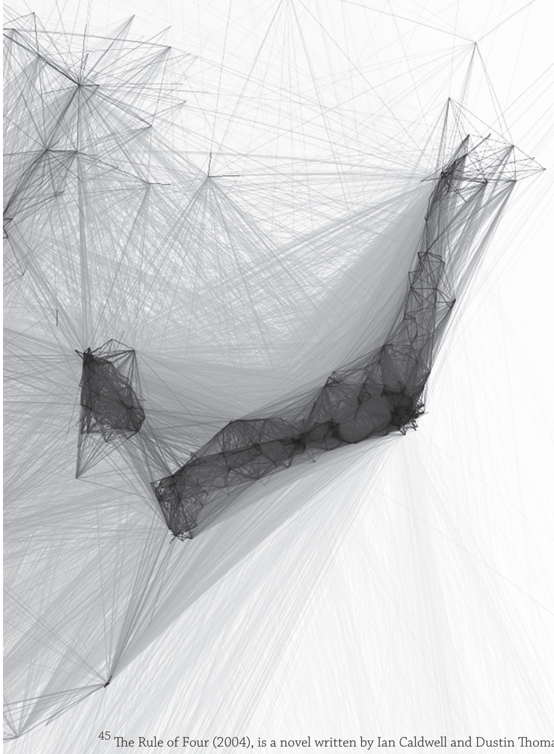
6

SIX | Creating the ESP PANDORA

"Hope, which whispered from Pandora's box,
after all the other plagues and sorrows had escaped,
is the best and last of all things.
Without it, there is only time."

The Rule of Four[45]

This chapter constitutes the realisation of the Experimental Scenario Platform "PANDORA" by which we will assess the potential of the ESC12 scenario model.



[45] The Rule of Four (2004), is a novel written by Ian Caldwell and Dustin Thomason. The novel charts the relationship between four roommates who try to solve the mysteries of the book Hypnerotomachia Poliphili.

To be able to test the capabilities of the ESC12 scenario model designed in chapter five, we will build an Experimental Scenario Platform (ESP). The ESP is expected to allow us to answer RQ3 and RQ4 adequately. We will answer RQ3 in chapter seven, and RQ4 in chapter eight. This chapter will constitute the realisation of the ESP.

As a guideline for the reader we define the term Experimental Scenario Platform (ESP) that from this chapter onwards will be used throughout this thesis. We define ESP as follows.

Definition 6.1: Experimental Scenario Platform (ESP)

The Experimental Scenario Platform (ESP) is the combination of the ESC12 scenario model as proposed in this thesis combined with an arbitrary dataset of criminal behaviour. An ESP is used to enable the further development and testing of the ESC12 scenario model[46]*.*

To discern the conceptual ESC12 scenario model proposed in chapter four from the Experimental Scenario Platform we will assemble in this chapter, we have given the latter a name: PANDORA. Pandora is an obvious reference to Pandora's box, an artefact from classical Greek mythology. Pandora, according to the myth, was the first woman on earth. She was sent by the gods and given a container that she was urged never to open for it contained all evil of the world. However, impelled by curiosity, Pandora opened the container and released its evil contents. The one item that remained at the bottom of the container was Hope (Hesiod, 700 BCE).

Advancing on this analogy, one may regard the architectural design of the ESC12 scenario model proposed in chapter five as the "box", and the dataset that will be attached to the model, as its "contents". By adding data from terrorist incidents to the scenario model we aim to create the ESP PANDORA that contains violent historic incidents that caused harm and grief to many people. Opening this "box" will unleash its "evil contents". However, it will also allow us to study the predicaments of criminal behaviour; something that, when related to Greek mythology, can be seen as the item that remained at the bottom.

[46] Obviously, more than one ESP can be created since there is more than one dataset related to criminal behaviour.

Since RQ3 and RQ4 are formulated to assess two distinctly different capabilities of the ESC12 scenario model, we will create two different ESPs: PANDORA I and PANDORA II.

This chapter advances on the studies by two Master students, viz. Van der Heide (2011) and Bressers (2012) who extensively tested and improved the ESP PANDORA, as well as its Elementary Scenario Components and their corresponding variables (see also section 1.8 "Publications arising from this thesis").

The chapter will start with a brief outline of the data gathered in ESP PANDORA (section 6.1). In section 6.2 the ESC12, the variables they comprise, and their internal structure will be discussed. Section 6.3 will elaborate on the ESP PANDORA I that we use to provide an answer to RQ3 in chapter seven, and the ESP PANDORA II to answer RQ4 in chapter eight. Section 6.4 summarises this chapter.

6.1 Data in PANDORA

Both the ESP PANDORA I and ESP PANDORA II combine the conceptual design of the ESC12 scenario model proposed in chapter four, with a dataset of terrorist incidents (see definition 6.1). Adding data to the model brings about two limitations that need to be considered: sampling of crime-related data (subsection 6.1.1) and the limitations of using open-source data (subsection 6.1.2). To ensure that our findings and outcomes are evaluated with the appropriate level of caution, it is crucial to identify these limitations as potential shortcomings of the ESP PANDORA.

6.1.1 Sampling of crime-related data

In this thesis we will work with a sample of information: data from the field of terrorism as a subset of the entire population of criminal data. Based on the principle of inferential statistics, a sample of data from the narrow domain of terrorism will be collected. This data will be added to the ESC12 scenario model to create the ESP PANDORA, and will be used to draw inferences about the general population from which it was drawn.

The bias of such a sample is something that is hard to establish, but can be suspected to be noteworthy. Emblematic for data from the field of law enforcement, is that access is limited. It is said that everything we know of crime and criminals is based on a relatively small amount of information gathered from a small population of criminals, generally the unsuccessful ones. Obviously, (a) criminals who were not arrested, and (b) crimes that were not detected, undeniably hold valuable information for analysis, but are usually not identified and documented, and therefore not included in criminal research (cf. McCue, 2007).

In the field of terrorism research the situation is different. Because of the impact on society, the research of terrorist attacks is neither limited to the successful ones, nor to the incidents in which the terrorist were arrested. However, this does not imply that the available information is fully representative. Typically, much of the data concerning terrorist incidents is gathered in retrospect and it is only after the incident that behaviour is identified and linked. Even in the cases in which researchers have had access to people involved in, or associated with, terrorism (e.g., Merari, 2010; Soibelman 2004) the bias of the information is hard to ascertain. After all, the personal accounts of the respondents are likely to be distorted by their own views of the success or failure of their actions, as well as the situation in which their actions are reviewed. We conclude by stating that the sampling of crime-related data is a difficult challenge as retrospective identification, characterisation, and analysis is suspected to have a negative effect on the reliability and validity of the data.

6.1.2 Limitations of using open-source data

In creating an ESP we will add open-source data to the ESC12 scenario model. Open-source data brings about three issues that need to be considered: (1) the reliability of data, (2) the consistency of data, and (3) the fuzziness of data.

1 The reliability of data

In law enforcement, there is a strong correlation between verified and classified information. The process of verification of information (i.e., the reliability of data) inevitably leads to restrictions, such as the ones concerning safety, accessibility, and levels of classification.

Good practice of scientific inquiry requires that data and methodology are documented and made public. This full disclosure, by definition, excludes the use of classified information. Therefore, in creating the ESP PANDORA we decided that the practice of scientific inquiry prevailed over the use of more reliable, classified information. However, this may imply that the potential of the model is negatively influenced by the data. Moreover, we reiterate that the extent to which the outcome of the model is biased, remains something that is hard to assess.

2 The consistency of data

The second issue related to open-source data collection is the consistency of information. Different sources do not always provide the same data on the same topic. In creating the ESP PANDORA, we used the following two rules.

1. When contradictory information in different sources was found, we opted to accept the facts supported by the majority of the sources.
2. In cases where there was no majority, we adopted the facts that seemed most plausible for us as researchers.

3 The fuzziness of data

The third issue that relates to open-source data collection is the fuzziness of data. For instance, data on variables as *Motivation*, *Primary objective*, *Symbolism*, and *Red herring* is non-objective and open for interpretation (see figure 4.2). To address the issue of the fuzziness of data adequately, we used the following two rules.

1. When data from sources was unclear, or fitted multiple alternative explanations, the term "miscellaneous" was used.
2. When no data was found, the field was left blank or listed "Unspecified".

6.2 Subdividing the ESC12

The ESC12 are the main categories on which the ESC12 scenario model is based. Taken together, they form the narrative or scenario of an event. However, as argued in chapter four, the ESC12 represent categories too broad and general for analysis.

In order to be made suitable for the ESC12 scenario model, we subdivide every Elementary Scenario Component into a set of variables. Effectively, these variables and their internal structure will guide the pre-processing of data that takes place in the module "the data cruncher" (see subsection 5.3.2). Below we briefly introduce the variables that are included in the ECS 12 scenario model. Moreover, we provide the classification of the variables. In chapter seven we will describe the internal structure of the ESP PANDORA and the variables that were selected for inclusion in our ESC12 scenario model.

To crunch the data and to distinguish relevant data from less relevant data with respect to historical criminal incidents, we arrived at 98 variables. In subdividing the ESC12, we used four types of values: (1) dichotomous values (such as yes/no and male/female), (2) numerical values, (3) categorical values, and (4) text values. Table 6.1 presents the value of the variables related to the ESC12. (We remark that the two Elementary Scenario Components *Symbolism* and *Red herring* are related to the remaining 10 Elementary Scenario Components (see subsection 4.2.2 and table 4.3). Therefore, *Symbolism* and *Red herring* do not possess idiosyncratic variables and are consequently not included in table 6.1.)

	ESC12	Dichotomous value	Numerical value	Categorical value	Text value
1	*Arena*	2	-	4	4
2	*Time(frame)*	-	1	3	2
3	*Context*	-	-	1	1
4	*Protagonist*	5	3	4	14
5	*Antagonist*	2	1	8	6
6	*Motivation*	-	-	1	1
7	*Primary objective*	-	-	1	1
8	*Means*	1	1	6	7
9	*Modus operandi*	1	-	3	6
10	*Resistance*	2	1	2	3
	Total variables (98)	**13**	**7**	**33**	**45**

Table 6.1 The values for the 98 variables of the ESC12.

In chapter seven "Developing the ESP PANDORA" we will further elaborate on the variables of the ESC12 scenario model and on their internal structure. For now it is sufficient to know that the ESC12 constitute 98 variables.

6.3 Creating two platforms

To answer RQ3 [*To what extent can a scenario model be used to analyse historic criminal behaviour?*] we required an experimental scenario model that is able to hold detailed information about terrorist incidents. For this specific reason we created the ESP PANDORA I, which holds elaborate and detailed information about a relatively small number of terrorist incidents. Subsection 6.3.1 will further elaborate on PANDORA I.

To be able to answer RQ4 [*To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law enforcements agencies to anticipate criminal behaviour?*] we required a model that primarily encompasses a large number of terrorist incidents. For that reason, we enhanced the ESP PANDORA I with terrorist incidents taken from a third party database. The database that was created accordingly was named PANDORA II. While the incidents recorded in PANDORA II are recorded in much less detail that the incidents recorded in PANDORA I, it holds general information about a relatively large number of terrorist incidents. However, in answering RQ4, the number of incidents prevails over the level of detail per incident. Subsection 6.3.2 will further elaborate on the ESP PANDORA II.

Below we will explain both the ESPs and how they were created. For a perception of the chronological order of the development of the platform, we refer to the papers (listed in section 1.8) that were published on the progress of the PANDORA models.

6.3.1 PANDORA I

We created the ESP PANDORA I by adding data from 157 terrorist incidents to the ESC12 scenario model. We accumulated terrorist incidents from OSINT data, extracted the relevant information, and added it to one of the variables of the ESC12 (see Van der Heide, 2011).

Apart from dichotomous values, numerical values, and text values, the model contains categorical values. Obviously, a number of the categorical values could be determined in advance (e.g., the variable "Day of the week" consists of seven values). However, other categorical values grew empirically. For instance, when we were adding data to the model, we determined different manners in which incidents are claimed. To be able to include this information in the ESC12 scenario model, we introduced the variable "Mode of claim of responsibility", and created categorical values from the different ways in which incidents are claimed. When we found a manner of claiming responsibility that did not seem to fit the categorical values that were created, we added a new categorical value. Box 6 illustrates how the list of variables and categorical values grew empirically, by an operational example.

Box 6: An operational illustration

When adding data from the assassination of Van Gogh to PANDORA I, we learned that the note, by which the protagonist claimed the responsibility, was left in a rather peculiar manner. It was knifed to the chest of the antagonist. Instead of adding the categorical value "Note knifed to chest of antagonist" to the existing list of categorical values of the variable "Mode of claim of responsibility", we decided to introduce a new variable; "Description of Claim of responsibility". This variable allows adding specific details (as text value) to the ESC12 scenario model.

Arguably, when knifing letters to the chest of an antagonist becomes characteristic, this method of claiming responsibility could or should be added to the categorical values of the variable "Mode of claim of responsibility".

Throughout the process of adding data to the ESP PANDORA I, the variables of the ESC12 empirically advanced and improved. During the development of the ESP PANDORA, minutes of the changes have been kept; so, future users can trace the modifications and use this information to explore or enhance the model (cf. Bressers, 2012).

PANDORA I contains 157 individual terrorist incidents, deconstructed into 12 Elementary Scenario Components (rows) and subdivided into 98 variables (columns) per incident. With its 15,386 fields this constitutes the most elaborate, unclassified database of terrorist incidents in the Netherlands at the time of publication of this thesis.

While 157 unique terrorist incidents might contain sufficient information for qualitative research, this number of records is not sufficiently large to guarantee the reliability of the results in a quantitative analysis. Therefore, to approach the fourth research question [*To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law-enforcement agencies to anticipate criminal behaviour?*], we needed to expand the ESP PANDORA I significantly.

6.3.2 PANDORA II

In *Short-term forecasting of crime*, Gorr et al. (2003) stated that one of the main problems with crime anticipation is that the models are using small-scale data series. Brown et al. (2004) argued that since terrorist attacks are relatively rare, they have only a few data points to make their forecast models. As forecast errors increase as data aggregations become smaller (Gorr & Harries, 2003), the ESP PANDORA I needed to be expanded in order to address these challenges adequately.

PANDORA II is first described in *Pandora II, Improvements to a scenario model for investigation of terrorist behaviour* by Bressers (2012). She suggested to expand the ESP PANDORA I considerably in order to make it usable for statistical analysis. Following this suggestion we (i.e., our team; supervisors, advisory board, and students) investigated to what extent PANDORA I could be merged with the Global Terrorism Database (GTD), an open-source database including more than 104,000 records on terrorist events throughout the world (National Consortium for the Study of Terrorism and Responses to Terrorism, 2012)[47]. The GTD includes cases from 1970 and can be accessed through an online interface. Although the data of each individual terrorist incident is limited, the GTD constitutes the largest number of incidents in an unclassified dataset on terrorist events in the world.

After comparing all variables of PANDORA I with those of the GTD, it appeared that the two databases had some fundamental differences. Most importantly, PANDORA I is based on the classical scenario components of the creative industry and therefore incorporates some very specific variables such as *Symbolism* and *Red herring*. These components were not found in the GTD, neither were other more straightforward variables such as "time" that describes the exact time an incident took place or "leakage" that describes whether there was a leakage[48] before, during, or after the incident.

[47] The Global Terrorism Database (GTD) is an open-source database that includes information on terrorist events around the world from 1970 through 2012 (National Consortium for the Study of Terrorism and Responses to Terrorism, 2012).

[48] Leakage in this context refers to any form of (un)intentional communication of intentions.

In total, the GTD supported only 24 of the 98 variables of the ESC12 scenario model. However, we established that this would be a good start to address RQ4 adequately. Therefore, we decided to merge the PANDORA I with GTD in a new and expanded ESP that we named PANDORA II.

PANDORA II was formatted in an Open Office file. As Open Office files are restricted to a maximum of 65,000 records, we did not use all the incidents recorded in the GTD. We commissioned cases from the year 1991 until the year 2010.

Notably, as only 22 of the 98 PANDORA variables were logged in the GTD, 76 fields were left blank in the ESP PANDORA II. Additionally, variables of the GTD that did not fit within the scenario concept were excluded from PANDORA II. For a detailed description of the merging of the ESP PANDORA I, and the GTD, we refer to *Pandora II, Improvements to a scenario model for investigation of terrorist behaviour* by Bressers (2012). Together with the 157 cases of PANDORA I, the total number of cases in the ESP PANDORA II accumulates to 53,289.

6.3.3 Section conclusion

With the creation of the ESPs PANDORA I and PANDORA II, we believe to be adequately equipped to address RQ3 and RQ4. We include table 6.2 to provide a convenient comparison of the number of incidents, and number of variables in PANDORA I and PANDORA II.

ESP	RQ	Number of incidents	Number of variables
PANDORA I	3	157	98
PANDORA II	4	53,289	24

Table 6.2 A comparison of the ESPs PANDORA II and PANDORA II.

6.4 Chapter Summary

In this chapter we argued that the conceptual idea of the ESC12 scenario model able to anticipate criminal behaviour, as proposed in chapter five, needs to be assessed through the creation of an Experimental Scenario Platform (ESP). This chapter described the development of the ESP named PANDORA.

First, we addressed the sampling of the data to be used in the ESP and the limitations related to the use of open-source data. We discussed three limitations viz. (i) the reliability of data, (ii) the consistency of data, and (iii) the fuzziness of data.

Second, we argued that the ESC12 represent categories that are too broad and general for use in a scenario model able to anticipate criminal behaviour. The process of crunching the data and subdividing the ESC12 into a range of variables is explained. Arguments and a line of reasoning for a proper subdivision of the variables will be given in chapter seven.

Third, we considered an adequate answering procedure for RQ3 as well as for RQ4. We arrived at two different and possibly idiosyncratic models. Subsequently, we explained the development of the ESP PANDORA I containing detailed information of 157 terrorist incidents. Thereafter, we explained the process of merging PANDORA I with the Global Terrorist Database to create the ESP PANDORA II.

Having assembled two ESPs we can now focus on the internal structure of the ESP and the process of data preparation. This will be the subject of the next chapter.

7

The value of any piece of information is only known when you can connect it with something else that arrives at a future point in time. It is all about being able to correlate data ahead of time, to see how things are related.

Gus Hunt[49]

SEVEN | Developing the ESP PANDORA

This chapter focusses on the internal structure of the ESP PANDORA and on the process of data pre-processing.

[49] Ira "Gus" Hunt is currently the Chief Technology Officer for the Chief Information Officer at the Central Intelligence Agency (CIA).

Law-enforcement reports on criminal incidents consist of intricate patterns of complex information that is incongruous in nature (cf. McCue, 2007). To be able to accumulate data from different criminal incidents in the ESC12 scenario model, data has to be "crunched" and pre-processed (see chapter five). This chapter focusses on the internal structure of the ESP PANDORA and on the process of data pre-processing.

A total of three Master students contributed to this chapter: Van der Heide, 2011; Bressers, 2012; and Stege, 2012 (see also section 1.8 "Publications arising from this thesis"). This chapter advances on their studies.

The chapter comprises thirteen sections. In section 7.1 we describe the development of the ESP PANDORA and the methodology for identifying the relevant variables. In the subsequent sections (7.2 to 7.12) we describe the internal structure of the ESP PANDORA. For convenient reading we have included a table in every section. Section 7.13 concludes this chapter with a chapter summary.

7.1 Development of the ESP PANDORA

In the research methodology described in chapter one, we introduced stage 3 "Create an Experimental Scenario Platform (ESP)" (see table 1.1). An important step in this process of creation is subdividing the twelve Elementary Scenario Components into variables. To guide us in this process, and to help us identify the relevant variables of the ESC12 scenario model, we used the technique of exploratory testing. In exploratory testing the focus lies on gaining insights into - and familiarity with- a domain where problems are in a preliminary stage of investigation (cf. Kaner, 2008). Exploratory testing is closely linked with the development of a scenario model (see section 3.4). It constitutes learning, awareness raising, stimulation of creative thinking, and investigating the relationship between societal processes (Van Notten, 2006).

We approached the process of exploratory testing by adding data of actual terrorist incidents to the ESC12 scenario model. By doing so, we learned from the data, while we were creating (and continuously adapting) the internal structure of the ESP PANDORA, according to what was learned. Effectively, we optimised the ESP PANDORA, by treating (a) learning and (b) adapting as mutually supportive activities. Below, we provide three examples.

1. When data was obviously related to one of the Elementary Scenario Components, we introduced it as a variable of that component (i.e., when we were investigating an incident and found that it occurred in Paris, we added the variable "City" to the Elementary Scenario Component *Arena*).
2. When, from the professional experience perspective, we assessed a certain variable to be relevant, we added that variable to the corresponding Elementary Scenario Component (i.e., from our experience in the field of close protection we understand that it is relevant to know whether an attack took place while the target was "en route" or stationary. Consequently, we introduced the variable "En route" to the Elementary Scenario Component *Arena*).
3. When we learned from the dataset that specific data appeared frequently, and seemed relevant, we introduced a new variable to one of the Elementary Scenario Components (i.e., from the dataset we learned that in several cases an (un)intentional communication of intentions occurred, -in the literature referred to as "leakage"-. Because we assumed that leakage plays an important role in the anticipation of criminal behaviour, we introduced the variable "Leakage" to the Elementary Scenario Component *Protagonist*).

Consequently, the internal structure of the ESP PANDORA empirically advanced and improved throughout the process of adding data. Notably, the technique of exploratory testing implies that the quality of the outcome relies on the freedom and responsibility of the people that perform the actual tests. To provide insight into our considerations with respect to the creation process, minutes have been kept of the changes to the internal structure of the ESP PANDORA (cf. Bressers, 2012).

Below, we will advance with the internal structure of the ESC12 and the 98 variables that were created in the process of exploratory testing. For convenient reading we include table 7.1 that lists the Elementary Scenario Components and the number of variables that are created for every component.

	ESC12	Variables
1	*Arena*	10
2	*Time(frame)*	6
3	*Context*	2
4	*Protagonist*	26
5	*Antagonist*	17
6	*Motivation*	2
7	*Primary objective*	2
8	*Means*	15
9	*Modus operandi*	10
10	*Resistance*	8
	Total variables	**98**

Table 7.1 The ESC12 and their 98 corresponding variables.

The sections 7.2 to 7.12 include tables (table 7.2 to 7.12) in which we have defined 5 columns of information. Below we describe the five columns.

Column 1: **Number of variable** (indicated as "#")

For an efficient discussion, we have attributed a reference number to every variable. This number is presented in the first column of every table.

Column 2: **Variable**

The second column denotes the variable of the specific Elementary Scenario Component.

Column 3: **Explanatory note(s)**

The third column constitutes an additional, more elaborate explanation of the variable of column 2.

Column 4: **For example**

For an adequate understanding of the variables of the ESC12 scenario model and their internal structure, we have included the fourth column. This column is added for illustrational purposes, and contains an example of data related to the assassination of the Dutch filmmaker Theo van Gogh[50]. In the tables below this information is printed in italics.

[50] We note that the purpose of this column is purely illustrational. It is by no means our intention to provide an exhaustive overview of the circumstances surrounding Van Gogh's assassination.

Column 5: **Type of variable**

The fifth column contains the type of the variable. We have distinguished four types of variable: (1) dichotomous variables (such as yes/no and male/female), (2) numerical variables, (3) categorical variables, and (4) text variables. For a listing of the ESC12 and their corresponding types of variables, we refer to table 6.1.

The sections 7.3 to 7.12 correspond to the Elementary Scenario Components listed in table 7.1. In addition to these ten Elementary Scenario Components[51], we have added an additional section (section 7.2) in which we summarise the general information related to an incident. This section does not relate to any of the ESC12 and is purely added for convenient reading.

When, in the forthcoming tables below, a categorical variable is included, we will list the values of that category. For a convenient discussion, we use a format in which "*Antagonist* V5 cat 1" would indicate that we are discussing the fifth variable of the table ("V5") of the elementary scenario component *Antagonist*, and more precisely the first category ("cat 1") of that variable. This format will be used frequently throughout the next chapters.

[51] As explained in subsections 4.2.1 and 4.2.3, the Elementary Scenario Components *Symbolism* and *Red herring* are only used in conjunction with other scenario components. They are therefore not listed as separate sections in this chapter.

7.2 General information

The table "General Information" summarises the general information about a terrorist event and constitutes five variables.

General information				
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of Variable**
1	Case ID	Label of incident	*Van Gogh*	Text
2	Attack type	Classification of incident	*Assassination*	Category
3	Background	Short summary of incident	*Assassination of Theo van Gogh*	Text
4	Successful incident	Was the incident regarded successful?	*The incident was successful*	Dichotomous
5	Sources	Sources of information that were used to obtain information about the incident	*(Buruma, 2007)*	Text

Table 7.2 PANDORA: General information.

Variable 1: Case ID
In the variable Case ID, every case is attributed a unique identification number.

Variable 2: Attack type
The categorical variable Attack type captures the general category of terrorist act and often reflects the broad category of tactics used. The variable consists of the following nine categories that are based on the Global Terrorism Database (GTD).

V2 cat 1: Assassination

An incident with the primary objective to eliminate opponents. This variable does not to include attacks on non-specific members of a targeted group. The killing of a police officer would be labelled as "Armed assault" (unless there is reason to believe the attackers singled out a particularly prominent officer for assassination).

V2 cat 2: Armed assault

An incident directed at causing physical harm or death to human beings by any means other than an explosive.

V2 cat 3: Bombing / explosion

An incident in which effects are caused by an energetically unstable material undergoing rapid decomposition and releasing a pressure wave that causes physical damage to the surrounding environment.

V2 cat 4: Hijacking

An incident directed at taking control of a vehicle such as an aircraft, boat, or bus, with the purpose of diverting it to an un-programmed destination, obtain payment of a ransom, force the release of prisoners, or some other political objective. Hijackings are separated from hostage taking because in hijacking the primary target is a vehicle, regardless of whether there are people/passengers in the vehicle.

V2 cat 5: Hostage taking (barricade incident)

An incident directed at obtaining political or other concessions in return for the release of prisoners (hostages). Such incidents are separated from kidnapping since hostage taking (barricade incident) usually occurs, and plays out, at the target location with little or no intention to hold the hostages for an extended period in a separate clandestine location.

V2 cat 6: Hostage taking (kidnapping)

Hostage taking (kidnapping) can be distinguished from Hostage taking (barricade incident) by the intention to move and hold the hostages in a clandestine location. Usually in kidnappings the victims are selected beforehand.

V2 cat 7: Facility / Infrastructure attack

An incident, excluding the use of an explosive, executed to cause damage to a non-human target, such as a building, monument, train, or pipeline. Facility / Infrastructure attacks consist of actions primarily aimed at damaging property, or at causing a diminution in the functioning of a useful system (mass disruption) yet not causing direct harm to people. Facility / infrastructure attacks include arson and various forms of sabotage and may include acts that intend to cause harm to people as a result of the harm done to objects (e.g., blowing up a dam so that the ensuing flood will kill residents downstream). This category includes acts which aim to harm an installation, yet also cause harm to people incidentally.

V2 cat 8: Unarmed assault

An incident aimed at causing physical harm or death directly to human beings by any means other than explosive, firearm, incendiary, or sharp instrument (knife, etc.).

V2 cat 9: Unspecified

The attack type cannot be determined from the available information.

Variable 3: Background

The text variable Background allows a short textual description of the incident.

Variable 4: Successful incident

The dichotomous variable Successful incident allows the entry of an incident being valued as successful. The success of an incident may be hard to establish but is related closely to the Elementary Scenario Component *Primary objective* and *Means*. For instance, the *Primary objective* could be to generate media attention by means of creating an explosion that causes physical harm to people. When in this case, the device explodes but fails to harm people, yet generates media attention, we would assess the incident as successful.
The two dichotomous values are:
V4 cat 1: The incident was successful.
V4 cat 2: The incident was not successful.

Variable 5: Sources

The text variable Sources leaves room to indicate the sources that were used to obtain information of the particular incident.

Notably, the category General Information does not relate to any of the ESC12 and is purely added to summarise the general information about an incident.

7.3 Elementary Scenario Component 1: *Arena*

The Elementary Scenario Component *Arena* describes where the terrorist act took place, in what geographic location and what type of environment. The Elementary Scenario Component *Arena* and its ten corresponding variables are explained in table 7.3.

		Arena		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Region	In which region did the incident take place?	*Western Europe*	Category
2	Country	In which country did the incident take place?	*Netherlands*	Category
3	City	In what city did the incident take place?	*Amsterdam*	Text
4	Kill zone	Was the arena urban or rural?	*Urban*	Dichotomous
5	Static location	At which type of a static location did the incident take place?	*Other*	Category
6	En route	On which type of route did the incident take place?	*Home-work (or vice versa)*	Category
7	Public route/ location	Was the route / static location publicly known?	*Yes*	Dichotomous
8	Description of arena	Additional description related to the Elementary Scenario Component *Arena*	*Work address was public, home address was easy to find through OSINT/HUMINT*[52]	Text
9	Symbolism	Is a symbolic value associated with the Elementary Scenario Component *Arena*?	-	Text
10	Red herring	Is a Red herring associated with the Elementary Scenario Component *Arena*?	-	Text

Table 7.3 PANDORA: Arena.

Variable 1: Region

The categorical variable Region identifies the area in which the incident occurred. The regions are divided into the following thirteen categories that are taken from the GTD. An explication of the regions can be found in appendix A.

The 13 regions are

V1 cat 1: North America Canada, Mexico, United States

V1 cat 2: Central America & Caribbean

V1 cat 3: South America

V1 cat 4: East Asia

V1 cat 5: Southeast Asia

[52] OSINT: Open-source Intelligence. HUMINT: Human Intelligence

V1 cat 6: South Asia
V1 cat 7: Central Asia
V1 cat 8: Western Europe
V1 cat 9: Eastern Europe
V1 cat 10: Middle East & North Africa
V1 cat 11: Sub-Saharan Africa
V1 cat 12: Russia & the Newly Independent States (NIS)
V1 cat 13: Australia & Oceania

Variable 2: Country
The categorical variable Country identifies the nation where the incident occurred. The categories are derived from the GTD and include non-independent states, dependencies, and territories, such as Northern Ireland and Corsica. When an incident occurred in international waters or airspace, the country of departure is listed as the country of the incident. If the departure point is not identified, the incident is classified as International. In the case where the country in which an incident occurred cannot be identified, it is classified as Unspecified.

Note that the political circumstances of many countries have changed over time. In a number of cases, countries that represented the location of terrorist attacks no longer exist; examples include West Germany, the USSR, and Yugoslavia. In these cases the country name for the year that the event occurred is recorded. As an example, a 1989 attack in Bonn would be recorded as taking place in West Germany (FRG). An identical attack in 1991 would be recorded as taking place in Germany. The list of country codes can be found in appendix B.

Variable 3: City
The text variable City identifies the name of the city in which the incident occurred.

Variable 4: Kill zone
The dichotomous variable Kill zone identifies the area where the actual incident took place. The variable consists of three categories.
V4 cat 1: Urban
V4 cat 2: Rural
V4 cat 3: Unspecified

Variable 5: Static location

The categorical variable Static location refers to the location where the incident took place (as opposed to "En route"). The location can be specified with values consisting of seven categories.

V5 cat 1: Home address
V5 cat 2: Workplace
V5 cat 3: Social location
V5 cat 4: Hotel / Motel
V5 cat 5: Other
V5 cat 6: N.A. (Not applicable)
V5 cat 7: Unspecified

Variable 6: En route

The categorical variable En route refers to whether the terrorist act was committed while the antagonist was on his way from work, home or a social event or vice versa. The variable consists of seven categories.

V6 cat 1: Home - Work (or vice versa)
V6 cat 2: Home - Social (or vice versa)
V6 cat 3: Work - Social (or vice versa)
V6 cat 4: Work - Work
V6 cat 5: Social - Social
V6 cat 6: N.A. (Not applicable)
V6 cat 7: Unspecified

Variable 7: Public route / location

The dichotomous variable Public route / location defines whether the route or location where the incident took place was publicly known (through media reports, social media postings etc., or by common knowledge) It relates to the level of intelligence that the *Protagonist* needed to have in order to prepare the incident. The variable "Public route / location" consists of three categories.

V7 cat 1: Public route / location
V7 cat 2: No public route / location
V7 cat 3: Unspecified

Variable 8: Description of arena

The text variable Description allows additional information about the arena being introduced into the scenario model.

Variable 9: Symbolism

The text variable Symbolism allows describing to what extent the Elementary Scenario Component *Arena* represents something else by means of association, resemblance, or convention.

Variable 10: Red herring

The text variable Red herring allows capturing whether the Elementary Scenario Component *Arena* was believed to have included a Red herring or false indicator.

7.4 Elementary Scenario Component 2: *Time(frame)*

The Elementary Scenario Component *Time(frame)* provides a detailed time line of the incident by listing six variables. Table 7.4 depicts the internal structure of the component *Time(frame).*

		Time(frame)		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Day of the week	Which day of the week did the event take place?	*Tuesday*	Category
2	Date	Day / month / year	*2/11/2004*	Numeric
3	Time	Format: Hour.minutes / AM-PM	*8.30 AM*	Numeric
4	Description of time(frame)	Additional description of the Elementary Scenario Component *Time(frame)*	-	Text
5	Symbolism	Is a symbolic value associated with the Elementary Scenario Component *Time(frame)*?	-	Text
6	Red herring	Is a Red herring associated with the Elementary Scenario Component *Time(frame)*?	-	Text

Table 7.4 PANDORA: Time.

Variable 1: Day of the week

The categorical variable Day of the week contains the weekday on which the incident occurred. It consists of seven values.

V1 cat 1: Monday

V1 cat 2: Tuesday

V1 cat 3: Wednesday

V1 cat 4: Thursday

V1 cat 5: Friday

V1 cat 6: Saturday
V1 cat 7: Sunday

Variable 2: Date
The numeric variable Date contains the date on which the incident occurred presented in the format [dd/mm/yyyy]. In the case of incident(s) occurring over an extended period, the field will record the day when the incident was initiated. The variable "Description of Time(frame)" (see variable 4) allows for additional details.

Variable 3: Time
The numeric variable Time identifies the exact time on which the incident occurred, presented in local time in the 24 hrs. format [hh:mm]. In the case of incident(s) occurring over an extended period, the variable records the time when the incident was initiated.

Variable 4: Description of time(frame)
The text variable Description of time(frame) allows for additional information to be recorded related to the time(frame) such as information about the extended period that the incident took place, or specific details about the time(frame) such as a holiday or remembrance day.

Variable 5: Symbolism
The text variable Symbolism allows describing to what extent the Elementary Scenario Component *Time(frame)* represents something else by means of association, resemblance, or convention.

Variable 6: Red herring
The text variable Red herring allows capturing whether the Elementary Scenario Component *Time(frame)* was believed to have included a Red herring or false indicator.

7.5 Elementary Scenario Component 3: *Context*

The Elementary Scenario Component *Context* captures the relevant background against which the incidents took place. It contains the variables Type and Description of context. Table 7.5 depicts these two variables and the internal structure of the component *Context.*

		Context		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Type of context	What was the type of context of the event?	*Religious*	Category
2	Description of type of context	Additional description of the Elementary Scenario Component *Context*	*The film "Submission" directed by Van Gogh, fuelled the debate on the nature of Islam.*	Text

Table 7.5 PANDORA: Context.

Variable 1: Type of context

The categorical variable Type of context allows input from a category that defines the type of the context. The six categories related to the variable are as follows.

V1 cat 1: Political

V1 cat 2: Economical

V1 cat 3: Religious

V1 cat 4: Personal

V1 cat 5: Miscellaneous

V1 cat 6: Unspecified

Variable 2: Description of type of context

The text variable Description of type of context allows additional information related to the type of the context of the incident to be recorded.

The Elementary Scenario Components *Symbolism* and *Red herring* are not deemed relevant in relation to this particular Elementary Scenario Component.

7.6 Elementary Scenario Component 4: *Protagonist*

According to the rules of creative scenarios, the plot revolves around the protagonist; the main character of the play (cf. Aristotle, trans. 1987). Congruently, the Elementary Scenario Component *Protagonist* may be regarded as the central component of the ESC12 model.

Table 7.6 lists the different variables that constitute the Elementary Scenario Component *Protagonist,* and its internal structure. It includes twenty-six variables that allow information concerning the protagonist to be recorded in the scenario model.

Protagonist				
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Confirmed protagonist	Is the protagonist known? (see also *Protagonist* V5)	*Yes*	Dichotomous
2	Number of protagonists involved	Number of protagonists that were involved	*1*	Numeric
3	Number of protagonists captured	Number of protagonists that were captured	*1*	Numeric
4	Number of protagonist fatalities	Number of protagonists involved / Number of protagonists that died during incident	*1/0*	Numeric
5	Incident attributed to	Name of protagonist(s)	*Mohammed Bouyeri*	Text
6	Description of background of protagonist	Additional description of the Elementary Scenario Component *Protagonist*	-	Text
7	Incident claimed by	Who claimed the incident?	*Mohammed Bouyeri*	Text
8	Description of claim of incident	Additional description of the claim of incident	-	Text
9	Mode of claim of responsibility	By which mode was the incident claimed?	*Letter*	Category
10	Description of claim of responsibility	Additional description of the claim of responsibility?	*A letter was knifed to the chest of the antagonist*	Text
11	Leakage	Did any form of leakage proceed the incident?	*No*	Dichotomous
12	Description of leakage	Description of leakage	-	Text
13	Protagonist's gender	What was the gender of the protagonist?	*Male*	Dichotomous

14	Age(group)	To which age group does the protagonist fit.	*20-30*	Category
15	Terrorist organisation	Was the protagonist known member of a terrorist organisation.	-	Category
16	Description of terrorist organisation	Additional description of terrorist organisation.	-	Text
17	Nature of incident	What is the nature of the incident?	*Lone Wolf*	Category
18	Description of nature of incident	Additional description of the nature of the incident	-	Text
19	Background/ history	Significant information about the background / history of the protagonist	-	Text
20	Part of multiple-incident	Was the incident part of a multiple-incident?	*No*	Dichotomous
21	Description of multiple-incident	Additional description of other incidents related to the protagonist or incident.	-	Text
22	Known previous incidents	Information about previous incidents related to the protagonist or the terrorist organisation.	-	Text
23	Known subsequent incidents	Information about subsequent incidents related to the protagonist or terrorist organisation.	-	Text
24	Ties with third parties	Are there ties between the protagonist and third parties?	*Yes*	Dichotomous
25	Description of ties with third parties	Additional details of ties between the protagonist and third parties.	*Bouyeri is believed to have close connections with (members of) the "Hofstad group"*	Text
26	Red herring	Is a Red herring associated with the Elementary Scenario Component *Protagonist*?	-	Text

Table 7.6 PANDORA: Protagonist.

Variable 1: Confirmed protagonist

The dichotomous variable Confirmed protagonist captures whether the identity of the protagonist is known. It accepts two values based on the GTD.

V1 cat 1: Confirmed

> Cases where credible, non-government analysts identify probable perpetrators receive a "Confirmed" in this variable. Cases where a government official expresses a definite position on the perpetrator based on intelligence or other information are equally labelled as "Confirmed". Cases where a terrorist organisation claims responsibility

for the attack are recorded as "Confirmed", unless the source specifically notes that authorities doubt the veracity of the claim.

V1 cat 2: Unconfirmed

"Unconfirmed" is used in all other cases.

Variable 2: Number of protagonists involved

The numeric variable Number of protagonists involved, captures the number of known protagonists that were involved in the incident. In cases where there are more than one protagonists involved, the variables name, sex, and age group, are multiplied in the ESP PANDORA.

Variable 3: Number of protagonists captured

The numeric variable Number of protagonists records, captures the number of known protagonists that were taken into custody.

Variable 4: Number of protagonist fatalities

The numeric value Number of protagonist fatalities, captures the number of protagonists that died as a result of the incident. The value will be presented in the format [#protagonists involved / #protagonists died].

Variable 5: Incident attributed to

The text variable Incident attributed to, allows additional information related to the attribution of the incident, to be introduced in the ESP PANDORA.

Variable 6: Description of background of protagonist

The text variable Description of background of protagonist, allows for an additional description of the protagonist.

Variable 7: Incident claimed by

The text variable Incident claimed by, captures the name of the person or organisation that claimed responsibility for the incident. To ensure consistency in the usage of group names, we use a standardised list of terrorist organisations that has been established by the GTD. Additional information on the claim of the incident may be recorded in the subsequent variable Description of claim of incident.

Variable 8: Description of claim of incident

The text variable Description of claim of incident allows for an additional description of the person or organisation that claimed responsibility for the incident.

Variable 9: Mode of claim of responsibility

The categorical variable Mode of claim of responsibility captures the manner by which the responsibility was claimed. These manners are divided into the following ten categories. If additional information exists (for instance, a particularly novel or strange mode is used), this information may be captured in the subsequent Description of claim of responsibility variables.

V9 cat 1: Telephone call
V9 cat 2: Letter
V9 cat 3: Note left at scene
V9 cat 4: Note left elsewhere
V9 cat 5: E-mail
V9 cat 6: Video
V9 cat 7: Posting at website
V9 cat 8: Personal claim
V9 cat 9: Other
V9 cat 10: Unspecified

Variable 10: Description of claim of responsibility

The text variable Description of the claim of responsibility, allows for an additional description of the claim of responsibility.

Variable 11: Leakage

The dichotomous variable Leakage identifies whether leakage preceded the incident. Leakage in this context refers to any form of (un)intentional communication of intentions. The variable contains three values.

V11 cat 1: Leakage
V11 cat 2: No leakage
V11 cat 3: Unspecified

Variable 12: Description of leakage

The text variable Description of leakage allows for recording additional information about the variable leakage.

Variable 13: Protagonist's gender

The categorical variable Protagonist's gender allows capturing the gender of the *Protagonist*. The variable includes three categories.

V13 cat 1: Male
V13 cat 2: Female
V13 cat 3: Unspecified

Variable 14: Age(group)

The categorical variable Age(group) allows capturing the age group of the *Protagonist*. It consists of twelve categories.

V14 cat 1: 0-10 years
V14 cat 2: 11-20
V14 cat 3: 21-30
V14 cat 4: 31-40
V14 cat 5: 41-50
V14 cat 6: 51-60
V14 cat 7: 61-70
V14 cat 8: 71-80
V14 cat 9: 81-90
V14 cat 10: 91-100
V14 cat 11: Miscellaneous
V14 cat 12: Unspecified

Variable 15: Terrorist organisation

The categorical variable Terrorist organisation allows recording the terrorist organisation the *Protagonist* was affiliated with. To ensure consistency in the usage of group names, we use a standardised list of group names that has been established by the GTD. Additional information on the terrorist organisation may be recorded in the subsequent variable Description of terrorist organisation.

Variable 16: Description of terrorist organisation

This text variable Description of terrorist organisation allows for additional information on the terrorist organisation to be introduced in the ESP PANDORA.

Variable 17: Nature of incident

The categorical variable Nature of incident allows capturing information about the nature of the incident. The variable includes six categories that are described below. Additional description may be recorded in the subsequent variable Description of nature of incident.

V17 cat 1: Nationalistic
V17 cat 2: Religious
V17 cat 3: Ideological
V17 cat 4: Lone operator
V17 cat 5: Miscellaneous
V17 cat 6: Unspecified

Variable 18: Description of nature of incident

The text variable Description of nature of incident allows for additional information on the nature of incident variable to be captured.

Variable 19: Background / History

The text variable Background / History allows for significant information about the background and / or history of the protagonist to be recorded.

Variable 20: Part of multiple-incident

The dichotomous variable Part of multiple-incident indicates whether the *Protagonist* was involved in previous or subsequent criminal or illegal activities. The variable Part of multiple-incident is loosely related to the Elementary Scenario Component *Modus operandi*. When the modus operandi of a protagonist includes a combination of multiple attacks that converge within a limited time frame, we classify an attack as Part of multiple-incident. Subsequent text values allow for more specific descriptions of these activities. The variables include two categories.

V20 cat 1: Part of multiple-incident
V20 cat 2: Not part of multiple-incident

Variable 21: Description of multiple-incident

The text variable Description of multiple-incident allows for capturing additional information concerning the multiple-incident related to the specific case.

Variable 22: Known previous incidents

The text variable Known previous incidents, allows for capturing additional information concerning earlier incidents to which the *Protagonist* was related.

Variable 23: Known subsequent incidents

The text variable Known subsequent incidents allows for capturing additional information concerning later incidents to which the *Protagonist* was related.

Variable 24: Ties with third parties

The dichotomous variable Ties with third parties refers to possible connections with any terrorist, criminal or clandestine groups that the protagonist was not officially affiliated with. A text value allows for additional details of these ties to be recorded. The variable includes three categories.

V24 cat 1: Ties with third parties

V24 cat 2: No ties with third parties

V24 cat 3: Unspecified

Variable 25: Description of ties with third parties

The dichotomous variable Ties with third parties refers to possible connections with any terrorist, criminal or clandestine groups that the protagonist was not officially affiliated with.

Variable 26: *Red herring*

The text variable Red herring allows capturing whether the variables that compose the Elementary Scenario Component *Protagonist* was believed to have included a Red herring or false indicator.

The Elementary Scenario Component *Symbolism* is not deemed relevant in relation to the Elementary Scenario Component *Protagonist*.

7.7 Elementary Scenario Component 5: *Antagonist*

The Elementary Scenario Component *Antagonist* captures the relevant information about the antagonist to whom the incident was directed. Table 7.7 lists the seventeen variables and internal structure of the Elementary Scenario Component *Antagonist*.

	Antagonist			
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Primary target	Was the antagonist a person or an object?	*Person*	Dichotomous
2	Number of antagonist(s) involved	The number of known antagonists involved in incident	*1*	Numeric
3	Specific / generic antagonist(s)	Was / were the antagonist(s) selected randomly or selectively from a target population.	*Specific*	Dichotomous
4	Selection of antagonist(s)	What was the possible rationale behind the selection of antagonist(s)?	*Significance of antagonist(s)*	Category
5	Type of antagonist(s)	What category can be assigned to the Type of antagonist(s)?	*Journalists/media*	Category
6	Description of the type of antagonist(s)	Additional information about the Type of antagonist(s) and possible relation to secondary antagonist(s)	-	Text
7	Name of antagonist(s)	Name of antagonist(s)	*Theo van Gogh*	Text
8	Description of antagonist(s)	Description of antagonist(s)	*Director of movie 'Submission'*	Text
9	Nationality of antagonist(s)	Nationality of antagonist(s)	*Dutch*	Category
10	Symbolism	Is a symbolic value associated with the Elementary Scenario Component *Antagonist*?	-	Text
11	Red herring	Is a Red herring associated with the Elementary Scenario Component *Antagonist*?	-	Text
12	Antagonist(s) die(s) from attack	Number of antagonist(s) that died from in relation to the incident. Encoded in the format [#protagonists involved / #protagonists died]	*1/1*	Category
13	Other fatalities	Were there other fatalities related to the incident?	*Yes*	Category
14	Total fatalities	How many fatalities were related to the incident?	*1*	Category
15	Other Injuries	Were there other casualties related to the incident?	*1*	Category
16	Total injuries	How many casualties were related to the incident?	*2*	Category
17	Description of fatalities / injuries	Additional description of fatalities / injuries	*A police officer was injured after falling from his motorbike.*	Text

Table 7.7 PANDORA: Antagonist.

Variable 1: Primary target

The dichotomous variable Primary target refers to the antagonist being a person or an object. The variable contains two categories.

V1 cat 1: Person
V1 cat 2: Object

Variable 2: Number of antagonists involved

The numeric variable Number of antagonists involved captures the number of known antagonists that were involved in the incident.

Variable 3: Specific / Generic antagonist(s)

The dichotomous variable Specific / Generic antagonist(s) refers to whether the antagonist(s) were selected randomly or selectively from a target population. The variable contains three categories.

V3 cat 1: Specific
V3 cat 2: Generic
V3 cat 3: Unspecified

Variable 4: Selection of antagonist(s)

The categorical variable Selection of antagonist(s) allows for capturing the rationale behind the selection of the antagonist(s). The variable contains eight categories.

V4 cat 1: Significance of antagonist(s)
V4 cat 2: Vulnerability of antagonist(s)
V4 cat 3: Level of grievance
V4 cat 4: Level of exposure
V4 cat 5: Significant date event
V4 cat 6: Iconic value of antagonist
V4 cat 7: Miscellaneous
V4 cat 8: Unspecified

Variable 5: Type of antagonist(s)

The categorical variable Type of antagonist(s) allows for a classification of the Type of antagonist(s) or target. The following twenty-two categories and the subsequent descriptions are taken from the GTD "Target Type" list.

V5 cat 1: Business

Business is defined as a collection of individuals or organisations engaged in a commercial or mercantile activity as a means of livelihood. This category includes companies, institutions, or private citizens patronising a business, such as a restaurant, gas station, music store, bar, café, and movie theatres. It also includes hospitals, chambers of commerce, and cooperatives. When an attack is carried out in public or quasi-public areas such as "business district or commercial area", (the attacks are captured under "Private Citizens and Property", (*Antagonist* V5 cat 14).

V5 cat 2: Government (general)

This category includes attacks on government buildings, government members, former government members (including members of political parties), their convoys, political movements; or government sponsored institutions provided the attack is carried out to harm the government. It includes attacks on judges, public attorneys (e.g., prosecutors), courts and court systems, politicians, royalty, head of state, government employees (unless police or military), election-related attacks, intelligence agencies and spies.

V5 cat 3: Police

This category includes attacks on members of the police force or police installations. It includes police boxes, patrols headquarters, academies, cars, checkpoints, etc. It also includes attacks against jails or prison facilities, or jail or prison staff or jail or prison guards. Moreover, it includes attacks against private security guards and security.

V5 cat 4: Military

This category includes attacks against army units, army personnel and equipment. It also includes attacks on recruiting sites, and soldiers engaged in internal policing functions such as at checkpoints and in anti-narcotics activities. Excluded are attacks against militia and guerrillas; these types of attacks are classified as "Terrorist" (*Antagonist* V5 cat 17).

V5 cat 5: Abortion related

Attacks on abortion clinics, employees, patrons, or security personnel stationed at clinics.

V5 cat 6: Airports & airlines

This category includes attacks carried out either against an airport or against an airplane. Attacks against airline employees while on board are also included in this value. Moreover, it includes attacks conducted against airport business offices and executives. Attacks where airplanes were used to carry out the attack (such as three of the four 9/11 attacks) are not included in this value.

V5 cat 7: Government (diplomatic)

This category includes attacks carried out against foreign missions, including embassies, consulates, etc. It also includes attacks on judges, public attorneys (e.g., prosecutors), courts and court systems, politicians, royalty, head of state, government.

V5 cat 8: Educational institution

This category includes attacks against (religious) schools, teachers, or guards protecting school sites. Includes attacks against university professors, teaching staff and school buses. If attacks involving students are not directed against a school, university or other educational institution, or are carried out in an educational setting, they are classified as private citizens and property. The category excludes attacks against military schools (attacks on military schools are classified as "Military," (*Antagonist* V5 cat 4).

V5 cat 9: Food or water supply

Attacks on food or water supplies or reserves are included in this category.

V5 cat 10: Journalists & media

This category includes attacks on reporters, news assistants, photographers, publishers, as well as attacks on media headquarters and offices. Attacks on transmission facilties such as antennae or transmission towers are included in this value (while attacks on broadcast infrastructure are classified as "Telecommunications," (*Antagonist* V5 cat 16).

V5 cat 11: Maritime

This category includes civilian ports and maritime facilities It includes attacks against fishing ships, oil tankers, ferries, yachts, etc. The categopry does not include attacks on fishermen as they are classified as "Private Citizens and Property," (*Antagonist* V5 cat 14).

V5 cat 12: Non Governmental Organisations (NGOs)

This category includes attacks on offices and employees of non-governmental organisations (NGOs). NGOs are defined as primarily large multinational non-governmental organisations. (These include the Red Cross and Doctors without Borders). The category does not include labour unions, social clubs, student groups, and other non-NGO (such cases are classified as "Other", (*Antagonist* V5 cat 13).

V5 cat 13: Other

This category includes attacks directed against antagonists that do not fit into other categories.

V5 cat 14: Private citizens & property

This category includes attacks on individuals, the public in general or attacks in public areas including markets and pedestrian malls. The category also includes incidents involving political supporters as private citizens and property, provided that these supporters are not part of a government-sponsored event. The category explicitly excludes attacks causing civilian casualties in businesses such as restaurants, cafes or movie theatres (these categories are classified as "Business", (*Antagonist* V5 cat 1).

V5 cat 15: Religious figures / institutions

This category includes attacks on religious leaders (including missionaries), religious institutions, religious places or objects. The category also includes attacks on organisations that are affiliated with religious entities that are not NGOs, businesses or schools.

Attacks on religious pilgrims are considered "Private citizens and Property" (*Antagonist* V5 cat 14).

V5 cat 16: Telecommunication

This category includes attacks on facilities and infrastructure for the transmission of information. More specifically the category includes equipment such as cell phone towers, telephone booths, television transmitters, radio, and microwave towers.

V5 cat 17: Terrorists

This category includes attacks directed towards terrorists or members of identified terrorist organisations (see "Terrorist organisations" in the Elementary Scenario Component *Protagonist,* V15). The latter are included in this category. "Membership" in this context, is broadly defined and includes informants for terrorist organisations, but excludes former terrorists. The value also includes cases involving the targeting of militia and guerrillas.

V5 cat 18: Tourists

Tourists are defined as persons who travel primarily for the purposes of leisure or amusement. Attacks included in this category must specifically target tourists (or (government) tourist offices), not just assault a business or transportation system used by tourists. The category does include the targeting of tour buses or "tours."

V5 cat 19: Transportation (other than aviation)

This category includes attacks on public transportation systems. The category also includes efforts to assault public buses, minibuses, trains, metro/subways, highways (if the highway itself is the target of the attack), bridges, roads, etc.

V5 cat 20: Unspecified

If the target type cannot be determined from the available information, the category Unspecified is selected.

V5 cat 21: Utilities

This category pertains to facilities for the transmission or generation of energy. For example, power lines, oil pipelines, electrical transformers, high tension lines, gas and electric substations, are all included in the category. The category also includes lampposts or streetlights. Attacks on officers, employees or facilities of utility companies excluding the type of faculties above are classified as "Business" (*Antagonist* V5 cat 1).

V5 cat 22: Violent political parties

This category pertains to entities that are both political parties (and thus, classified as Government) *and* terrorists. It is operationally defined as groups that engage in electoral politics and appear as *Protagonist* in the ESP PANDORA.

Variable 6: Description of Type of antagonist(s)

The text variable Description of Type of antagonist(s) allows for an additional description of the Type of antagonist(s).

Variable 7: Type of antagonist(s)
The text variable Type of antagonist(s) allows capturing the name of the person or the object that was / were targeted.

Variable 8: Description of antagonist(s)
The text variable Description of antagonist(s) allows the Type of antagonist(s) to be included in the dataset.

Variable 9:
The categorical variable Nationality of antagonist(s) allows the input of the nationality of the antagonist by country. For information about the country codes, we refer to the variable Country of the Elementary Scenario Component *Arena* (see *Arena* V2). The list of country codes can be found in appendix B.

Variable 10: Symbolism
The text variable Symbolism allows describing to what extent the Elementary Scenario Component *Antagonist* represents something else by means of association, resemblance, or convention.

Variable 11: Red herring
The text variable Red herring allows capturing whether the Elementary Scenario Component *Antagonist* was believed to have included a Red herring or false indicator.

Variable 12: Antagonist(s) died from attack
The numeric variable Antagonist(s) died from attack captures the number of antagonists that died as a result of the incident. The value is presented in the format [#antagonists involved / #antagonists died].

Variable 13: Other fatalities
The dichotomous variable Other fatalities captures whether or not other people died as a result of the incident.

Variable 14: Total fatalities
The numeric variable Total fatalities, allows the number of fatalities to be recorded.

Variable 15: Other injuries

The dichotomous variable Other injuries captures whether other people were injured as a result of the incident.

Variable 16: Total injuries

The numeric variable Total injuries captures the total number of injuries that are related to the incident. This category will be presented in the format [#protagonists involved / #protagonists died].

Variable 17: Description of fatalities / injuries

The text variable Description of fatalities / injuries allows additional information about the fatalities and / or injuries to be recorded.

7.8 Elementary Scenario Component 6: *Motivation*

The Elementary Scenario Component *Motivation* captures the relevant information related to the motivation of the protagonist. Table 7.8 lists the internal structure and the two different variables that constitute the Elementary Scenario Component *Motivation*.

		Motivation		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Possible motivation	What motivated the protagonist	*Moral outrage*	Category
2	Description of motivation	Additional explanation of motivation of protagonist	*Protagonist was offended by Van Gogh's film 'Submission' and wanted to kill the film director that insulted the prophet.*	Text

Table 7.8 PANDORA: Motivation.

Variable 1: Possible motivation

The categorical variable Possible motivation allows for description of the psychological features that drive the protagonist by one of six motivations. For a clarification of these motivations, we refer to subsection 2.2.3. The possible motivation of a protagonist may be described by one of six categories below.

V1 cat 1: Need
V1 cat 2: Greed
V1 cat 3: Power
V1 cat 4: Moral outrage
V1 cat 5: Glory
V1 cat 6: Unknown

Variable 2: Description of motivation

The text variable Description of motivation allows for textual elaboration on the possible motive of the protagonist for choosing the specific antagonist, date, or arena.

As the Elementary Scenario Component *Motivation* refers to the intrinsic disposition of the protagonist, the Elementary Scenario Components *Symbolism* and *Red herring* are not deemed relevant in relation to this particular scenario component.

7.9 Elementary Scenario Component 7: *Primary objective*

Table 7.9 lists the internal structure and the two different variables that constitute the Elementary Scenario Component *Primary objective*.

		Primary objective		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Initial aim of the protagonist	What was the initial aim the protagonist had in relation to the incident?	*Applying pressure*	Category
2	Description of initial aim	Description of initial aim of the protagonist	*The primary objective of the protagonist, was to apply pressure to prevent further insults to the Prophet and Islam by spreading fear among the people of the Netherlands,*	Text

Table 7.9 PANDORA: Primary objective.

Variable 1: Initial aim

The categorical variable Initial aim allows the Primary objective to be included in the scenario model. The variable constitutes nine categories.

V1 cat 1: Applying pressure
V1 cat 2: Media attention
V1 cat 3: Oppression
V1 cat 4: Emphasising cause
V1 cat 5: Extending influence
V1 cat 6: Eliminating opponent(s)
V1 cat 7: Training
V1 cat 8: Miscellaneous
V1 cat 9: Unspecified

Variable 2: Description of initial aim

The text variable Description of initial aim allows importing additional information about the primary objective of the incident into the ESC12 scenario model.

The Elementary Scenario Component *Symbolism* and *Red herring* are not deemed relevant in relation to the Elementary Scenario Component *Primary objective*.

7.10 Elementary Scenario Component 8: *Means*

The Elementary Scenario Component *Means* captures the relevant resources that the protagonist had to prepare for the execution of the incident. Table 7.10 lists the fifteen variables and the internal structure of the Elementary Scenario Component *Means*.

		Means		
#	**Variable**	**Explanatory note(s)**	*For example*	**Type of variable**
1	Type of incident	Classification of the type of incident.	*Assassination/liquidation*	Category
2	Description of incident	Description of means related to the incident.	-	Text
3	Weapon category	Classification of the weapon category.	*Firearms*	Category
4	Weapon sub-category	Classification of weapon sub-category.	*Handgun(s)*	Category
5	Description of Weapon (sub-) category	Description of Weapon (sub-)category.	*Croatian HS 2000, Kukri machete, butchers knife*	Text
6	Type of primary explosive	Classification of explosive.	-	Category
7	Amount of primary explosive	Amount of explosive used.	-	Numeric
8	Detonation	Classification of detonation of explosive.	-	Category
9	Description of explosive	Additional description of explosive / detonation.	-	Text
10	Suicide mission	Can the incident be classified as a suicide mission?	*Yes*	Dichotomous
11	Description of suicide mission	Additional description of suicide mission.	*Bouyeri planned to die in the attack to become a martyr*	Text
12	Delivery method	In what way was the weapon / explosive delivered?	-	Category
13	Description of transportation	Remarks on transportation of weapons, resources etc. / delivery method etc.	*Bicycle*	Text
14	Symbolism	Is a symbolic value associated with the Elementary Scenario Component *Means*?	-	Text
15	Red herring	Is a Red herring associated with the Elementary Scenario Component *Means*?	-	Text

Table 7.10 PANDORA: Means.

Variable 1: Type of incident

The categorical variable Type of incident classifies the incident in one of eleven categories taken from the GTD.

V1 cat 1: Assassination / Liquidation

V1 cat 2: Armed assault
V1 cat 3: Bombing
V1 cat 4: Hijacking
V1 cat 5: Hostage taking / Kidnapping
V1 cat 6: Vehicle attack
V1 cat 7: Computer network attack / Electronic warfare
V1 cat 8: CBRN
V1 cat 9: Other
V1 cat 10: Miscellaneous
V1 cat 11: Unspecified

Variable 2: Description of incident
The text variable Description of incident allows importing additional information about the primary objective of the incident.

Variable 3: Weapon category
The categorical variable Weapon category records the general category of the weapon(s) used in the incident. It consists of the following thirteen categories that were taken from the GTD.
V3 cat 1: Biological
V3 cat 2: Chemical
V3 cat 3: Radiological
V3 cat 4: Nuclear
V3 cat 5: Firearms
V3 cat 6: Explosives / Bombs / Dynamite
V3 cat 7: Fake Weapons
V3 cat 8: Incendiary
V3 cat 9: Melee
V3 cat 10: Vehicle (not to include vehicle-borne explosives, i.e., car / truck bombs)
V3 cat 11: Sabotage equipment
V3 cat 12: Other
V3 cat 13: Unspecified

Variable 4: Weapon sub-category
The categorical variable Weapon sub-category records a more specific value for most of the weapon category identified immediately above. The thirteen

categories below are taken from the GTD. Values for weapon category and corresponding sub-type are as follows:

V4 cat 1: Biological

[no corresponding weapon sub-categories]

V4 cat 2: Chemical

Subcat a: Poisoning

V4 cat 3: Radiological

[no corresponding weapon sub-categories]

V4 cat 4: Nuclear

[no corresponding weapon sub-categories]

V4 cat 5: Firearms

Subcat b: Automatic weapon

Subcat c: Handgun

Subcat d: Rifle/Shotgun (non-automatic)

Subcat e: Unknown gun category

Subcat f: Other gun category

V4 cat 6: Explosives/Bombs/Dynamite

Subcat g: Grenade

Subcat h: Land mine

Subcat i: Letter bomb

Subcat j: Pressure trigger

Subcat k: Projectile (rockets, mortars, RPGs, etc.)

Subcat l: Remote trigger

Subcat m: Suicide (carried bodily by human being)

Subcat n: Time fuse

Subcat o: Vehicle

Subcat p: Unknown explosive category

Subcat q: Other explosive category

V4 cat 7: Fake Weapons

[no corresponding weapon sub-categories]

V4 cat 8: Incendiary

Subcat r: Arson/Fire

Subcat s: Flame thrower

Subcat t: Gasoline or Alcohol

V4 cat 9: Melee

Subcat u: Blunt object

Subcat v: Hands, feet, fists
Subcat w: Knife
Subcat x: Rope or other strangling device
Subcat y: Sharp object other than knife
Subcat z: Suffocation

V4 cat 10: Vehicle (not to include vehicle-borne explosives, i.e., car / truck bombs)
[no corresponding weapon sub-categories]

V4 cat 11: Sabotage equipment
[no corresponding weapon sub-categories]

V4 cat 12: Other
[no corresponding weapon sub-categories]

V4 cat 13: Unspecified
[no corresponding weapon sub-categories]

Variable 5: Description of Weapon sub-category
The text variable Description of Weapon sub-category allows importing additional information about the weapon(s) and its (sub-)category that were used in the incident. Information may include the novel use of a weapon or innovative means of concealing a weapon, specific weapon models, relevant details of the weapons' origins, etc.

Variable 6: Type of primary explosive
The categorical variable Type of primary explosive records the general type of primary explosive used in the incident. It consists of two hundred and twenty-four categories that were taken from the GTD. For reasons of brevity we refer to Appendix C for the complete list of these values.

Variable 7: Amount of primary explosive
The numeric variable Amount of primary explosive captures the total amount of primary explosives that was used in the incident.

Variable 8: Detonation
The categorical variable Detonation allows capturing the method of detonation of the explosives used. It consists of eight categories.
V8 cat 1: Timer
V8 cat 2: Radio frequency

V8 cat 3: Pressure
V8 cat 4: Manually
V8 cat 5: Motion or trip-wire controlled
V8 cat 6: Miscellaneous
V8 cat 7: Other
V8 cat 8: Unspecified

Variable 9: Description of explosive
The text variable Description of explosive allows importing additional information about the explosives and ways of detonation that were used in the incident.

Variable 10: Suicide mission
The dichotomous variable Suicide mission captures whether the incident implied the planned death of (one of the) the protagonist(s) people died as a result of the incident. The variable consists of three categories.
V10 cat 1: Suicide mission
V10 cat 2: No suicide mission
V10 cat 3: Unspecified

Variable 11: Description of suicide mission
The text variable Description of suicide mission allows importing additional information about the incident.

Variable 12: Delivery method
The categorical variable Delivery method records the method of delivery of the weapon used in the incident. It consists of seventeen categories.
V12 cat 1: Ground-based vehicle
V12 cat 2: Water, vessel
V12 cat 3: Sub aquatic / scuba
V12 cat 4: Aircraft
V12 cat 5: Missile, surface to surface
V12 cat 6: Missile, surface to air
V12 cat 7: Missile, air to surface
V12 cat 8: Missile, air to air
V12 cat 9: Missile, unknown type
V12 cat 10: Suicide terrorist
V12 cat 11: Human host

V12 cat 12: Mail / post
V12 cat 13: Food / beverages
V12 cat 14: Water supply
V12 cat 15: Gaseous
V12 cat 16: Miscellaneous
V12 cat 17: Unspecified

Variable 13: Description of transportation
The text variable Description of transportation allows importing additional information about the explosives and ways of detonation that were used in the incident.

Variable 14: Symbolism
The text variable Symbolism allows describing to what extent the Elementary Scenario Component *Means* represents something else by means of association, resemblance, or convention.

Variable 15: Red herring
The text variable Red herring allows capturing whether the variables that constitute the Elementary Scenario Component *Means* were believed to have included a Red herring or false indicator.

7.11 Elementary Scenario Component 9: *Modus operandi*

The Elementary Scenario Component *Modus operandi* captures how the incident was prepared and in what order events took place. *Modus operandi* and its ten variables provide information about terrorist plans and how they are carried out. Table 7.11 shows the internal structure of this component.

Modus operandi				
#	**Variable**	**Explanation**	*For example*	**Type of variable**
1	Level of intelligence	What level of intelligence did the protagonist(s) need to attain for their actions?	*Low*	Category
2	Actual M.O.	Explanation of the M.O. What happened, in what order etc.	*Antagonist was shot eight times with a handgun. Subsequently, Protagonist cut Antagonist's throat, nearly decapitating him, and stabbed him in the chest. Two knives were left implanted in his torso, one attaching a five-page note to his body.*	Text
3	Pre-incident action(s)	Classification of Pre-incident action(s)	*Surveillance, terrorist training*	Category
4	Description of Pre-incident action(s)	Description of Pre-incident action(s)	*Route of antagonist was well known by protagonist*	Text
5	Post-incident action(s)	Classification of Post-incident action(s)	*Subsequent action(s)*	Category
6	Description of post-incident action(s)	Description of Post-incident action(s)	*Protagonist tried to flee and shot at several policemen and civilians*	Text
7	Communication	Was there any form of communication during, before or after the attack?	-	Dichotomous
8	Description of communication	Description of communication		Text
9	Symbolism	Is a symbolic value associated with the Elementary Scenario Component *Modus operandi*?		Text
10	Red herring	Is a Red herring associated with the Elementary Scenario Component *Modus operandi*?		Text

Table 7.11 PANDORA: Modus operandi.

Variable 1: Level of intelligence

The categorical variable Level of intelligence refers to how much knowledge the protagonist needed or attained prior to the execution of their actions. This can be one of four categories.

V1 cat 1: Low
V1 cat 2: Medium
V1 cat 3: High
V1 cat 4:Unspecified

Variable 2: Actual M.O.

The text variable Actual M.O. captures the storyline of the incident. In other words how the incident was prepared and in what order events took place. The different actions that occurred before and after the event can be described in Actual M.O. and stored in the subsequent variables Pre-incident action(s) and Post-incident action(s).

Variable 3: Pre-incident action(s)

The categorical variable Pre-incident action(s) records the actions that preceded the incident. It consists of ten categories.

V3 cat 1: Weapons / Material movement
V3 cat 2: Terrorist travel
V3 cat 3: Terrorist training
V3 cat 4: Surveillance
V3 cat 5: Infiltration
V3 cat 6: Test of security
V3 cat 7: Elicitation
V3 cat 8: Other
V3 cat 9: Miscellaneous
V3 cat 10: Unspecified

Variable 4: Description of Pre-incident action(s)

The text variable Description of Pre-incident action(s) allows for additional information related to Pre-incident action(s) to be included in the model.

Variable 5: Post-incident action(s)

The categorical variable Post-incident action(s) records the actions that followed the incident. It consists of nine categories.

V5 cat 1: Subsequent attack(s)
V5 cat 2: Subsequent action(s)
V5 cat 3: Incident claimed
V5 cat 4: Successful exfiltration
V5 cat 7: Other
V5 cat 8: Miscellaneous
V5 cat 9: Unspecified

Variable 6: Description of Post-incident action(s)
The text variable Description of Post-incident action(s) allows for additional information related to Pre-incident action(s) to be included in the model.

Variable 7: Communication
The dichotomous variable Communication captures whether there was evidence of (any form of) communication during, before, or after the attack? The variable consists of two categories:
V7 cat 1: yes
V7 cat 2: no

Variable 8: Description of communication
The text variable Description of communication allows for additional information related to communication to be included in the model.

Variable 9: Symbolism
The text variable Symbolism allows describing to what extent the Elementary Scenario Component *Modus operandi* represents something else by means of association, resemblance, or convention.

Variable 10: Red herring
The text variable Red herring allows capturing whether the variables that constitute the Elementary Scenario Component *Modus operandi* were believed to have included a Red herring or false indicator.

7.12 Elementary Scenario Component 10: *Resistance*

The Elementary Scenario Component *Resistance* refers to the obstacles that the *Protagonist* had to overcome to execute his plan. Table 7.12 lists the eight variables and internal structure of the Elementary Scenario Component *Resistance*.

		Resistance		
#	**Variable**	**Explanation**	*For example*	**Type of variable**
1	Protection	Did the antagonist have any form of close protection?	*No*	Dichotomous
2	Driver	Was the antagonist accompanied by a driver?	*N.A.*	Dichotomous
3	Number of protectors	How many protectors were there?	-	Category
4	Number of armed protectors	How many of the protectors were armed? Coded in the format {#protectore / #protectors armed]	-	Numeric
5	Procedure	What procedure did the protectors follow?		Text
6	Category of protection	What category can be assigned to the protection of the antagonist?	-	Category
7	Previous security breach	Has there been an earlier breach in security?	-	Text
8	Security intervention	Has there been a security intervention during / proceeding / preceding the attack?	-	Text

Table 7.12 PANDORA: Resistance.

Variable 1: Protection

The dichotomous variable Protection captures whether the antagonist had any type of protection. An explanation of the different types of protection included in the scenario model, may be recorded in the variable "Category of protection" (see variable 6). The variable Protection consists of two categories.

V1 cat 1: Protection

V1 cat 2: No protection

Variable 2: Driver

The dichotomous variable Driver captures whether the antagonist was accompanied by a driver / chauffeur at the time of the incident. When an incident did not take place when the antagonist was En route, the category Not Applicable is selected.

The variable consists of three categories.

V2 cat 1: Driver

V2 cat 2: No driver

V2 cat 3: Not applicable (N.A.)

Variable 3: Number of protectors

The numeric variable Number of protectors captures the number of people protecting the *Antagonist* at the time of the incident. The variable accepts "0" as input when the *Antagonist* was not protected or guarded by people at the time of the incident.

Variable 4: Number of armed protectors

The numeric variable Number of armed protectors captures how many of the protectors people protecting the antagonist were armed at the time of the incident. The variable is presented in the format [#protectors / #armed protectors]

Variable 5: Procedure

The text variable Procedure allows for additional information to be recorded about the procedures which the protectors followed before, during, and in response to the incident.

Variable 6: Category of protection

The categorical variable Category of protection records the protection that the antagonist had at the time of the incident. It consists of thirteen categories.

V6 cat 1: Armoured car class d

V6 cat 2: Armoured car class c

V6 cat 3: Armoured car class b

V6 cat 4: Armoured car class a

V6 cat 5: Armoured car class unknown

V6 cat 6: Travelling in convoy

V6 cat 7: Advanced protection team

V6 cat 8: Counter surveillance team

V6 cat 9: Body armour

V6 cat 10: RF jammers

V6 cat 11: Other

V6 cat 12: Unspecified

V6 cat 13: N.A.

Variable 7: Previous security breach
The text variable Previous security breach allows for the recording of information about earlier security breaches.

Variable 8: Security intervention
The text variable Security intervention allows for the recording of information about security interventions before, during, or in response to the incident.

The Elementary Scenario Components *Symbolism* and *Red herring* are not deemed relevant in relation to the Elementary Scenario Component *Resistance*.

7.13 Chapter summary

The ESC12 represent the twelve elementary components from which every scenario can be built. However, these components are considered too general to accommodate the relevant details of criminal behaviour. The process of subdividing the ESC12 into variables is described in this chapter.

First, we explained the process of exploratory testing by which we created an internal structure of the ESP PANDORA, and by which we arrived at a total of 98 variables that are related to the ESC12 (section 7.1).

In the subsequent eleven sections (section 7.2 to 7.12) we provided insight into the internal structure of the ESP PANDORA, and into the 98 variables it encompasses. Moreover, we illustrated how data is deconstructed and implemented in the ESP PANDORA The sections 7.2 to 7.12 include detailed tables that illustrate the Elementary Scenario Component, its corresponding variables, and its internal structure. For adequate understanding, we exemplified the internal structure of the ESP PANDORA by adding data from the assassination of the Dutch filmmaker Theo van Gogh.

Having established 98 variables of the ESC12, and the internal structure of the ESP PANDORA, we may commence by opening Pandora's box, and start analysing criminal behaviour. This will be the subject of the next chapter.

8

History serves as a monument to past achievements,
an inspiration to newly inducted members,
a database for operational achievements.

Military Misfortunes: The Anatomy of Failure in War[53]

EIGHT | Opening PANDORA's box

In this chapter we study how the ESP PANDORA I may be used to analyse historic criminal behaviour and we will answer the third research question.

[53] Military Misfortunes: The Anatomy of Failure in War (1985) is a study by Eliot Cohen and John Gooch. The authors examine three types of misfortune and show their implication in a variety of defeats in military campaigns of the twentieth century.

On April 9th 2011, shortly after noon, a man entered a shopping mall in the Netherlands, wearing a bulletproof vest and carrying a semi-automatic Smith & Wesson .22 long rifle, a Colt .45 pistol, and a Taurus .44 Magnum revolver. Three minutes later 6 people were shot dead, 17 people were injured (one of which would succumb to injuries later the same day), and the shooter had committed suicide (Openbaar Ministerie, 2011). This attack was the deadliest lone-operator incident[54] in the Netherlands since an individual drove his car into a crowd two years earlier, killing seven people and himself in an apparent attack on the Dutch Royal family.

In the aftermath of both the shopping mall shooting and the apparent attack on the Dutch Royal family, the investigative teams raised two questions: (1) could the incident have been prevented? and (2) would it be possible anticipate future lone-operator incidents? To approach both questions, the investigative teams needed a better insight into the predicaments of lone-operator behaviour.

The words quoted at the beginning of this chapter suggest that history can provide information to create "a database for operational achievements". The National Crime Squad of the Netherlands (one of the organisations investigating the aforementioned lone-operator incident) needed exactly that. In order to anticipate future behaviour, they required *general* characteristics of lone operators instead of *specific* characteristics of a single lone-operator incident. In other words, questions concerning the correlation between lone operators and mental health, or the relation between lone operators and their targets, were deemed essential but could not be answered from the data of the isolated incidents that were investigated. Therefore, the National Crime Squad expressed interest in using the ESC12 scenario model to detect general characteristics in the behaviour of lone operators[55].

The operational interest of the National Crime Squad coincided with the research stage in which we attempted to answer RQ3 [*To what extent can a scenario model be used to analyse historic criminal behaviour?*]. Therefore, we agreed to employ the ESC12 scenario model to analyse historic behaviour of lone operators. The analysis was conducted by Van der Heide and published in the Master thesis

[54] For the use of the term lone operators we refer to definition 2.4 of this thesis.

[55] At this point in time, the ESC12 scenario model was referred to as the "Pandora scenario model"

Individual terrorism, indicators of lone operators (Van der Heide, 2011). With her main research question *What is the time-independent profile for lone operator terrorists?*, Van der Heide focussed on the operational interest of the investigative teams[56]. To answer RQ3, we will build on her findings. To put it differently, the extent to which the scenario model allows specific analysis of historic behaviour of lone operators, will be critical in our analysis.

In section 8.1 we describe the research framework for the analysis performed in this chapter. In section 8.2 we present forty cases of lone-operator behaviour, and distribute them equally over the four waves of modern terrorism (i.e., we present ten lone-operator incidents per wave). In section 8.3 we present a cross-wave analysis of the results generated in the previous section, in an attempt to generate general characteristics of lone-operator behaviour[57]. Section 8.4 concludes this chapter by focussing on how the scenario model performs in analysing historic criminal behaviour. In effect, this section will be used to answer RQ3.

8.1 Research framework

Below, we present the research framework for our analysis of historic behaviour of lone-operator incidents. In subsection 8.1.1 we introduce six Elementary Scenario Components, the seventeen variables related to these components that we selected for our experiment. In subsection 8.1.2 we describe the process of case selection. We introduce the concept of four waves of modern terrorism by Rapoport (2004), and carefully select ten cases of lone-operator incidents for every wave. In subsection 8.1.4 we focus on the process of analysis of lone-operator behaviour.

8.1.1 Analysis based on ESC6 and 17 variables

To address both RQ3 and the operational need of the National Crime Squad, within a limited timeframe, we focus our analysis on six of the ESC12: *Arena*, *Protagonist*, *Antagonist*, *Motivation*, *Means*, and *Modus* Operandi. To distinguish this set of scenario components from the ESC12, we call them ESC6 (Something that exclusively happens in this chapter).

[56] Van der Heide used the ESC12 scenario model to answer the research question "What is the time-independent profile for lone-operator terrorists?"

[57] Sections 8.2 and 8.3 reflect the result of the cooperation with Van der Heide (2011).

Moreover, we identified seventeen variables (related to these six components) that encompass valuable information by which general characteristics in the behaviour of lone operators may be detected. The six Elementary Scenario Components and their respective variables are summarised in table 8.1. Please note that the numbering of the variables in table 8.1 coincides with the numbering of the same variables in chapter seven. For a more elaborate description of the ESC12 and the internal structure of the corresponding variables, we refer to chapter seven.

ESC	Variable	
Arena	Region (V1) Kill zone (V4) Static location (V5) En route (V6) Public route / location (V7)	In which region does the incident occur? Does the incident occur in an urban or rural zone? Does the incident occur at a static location? Does the incident occur while the antagonist was en route? Is the route / location publicly known?
Protagonist	Confirmed Protagonist (V1) Description of background (V6) Protagonist's gender (V13) Protagonist's Age(group) (V14)	Is the protagonist known? Additional details of the background of protagonist What is the gender of the protagonist? Which age group does the protagonist fit into?
Antagonist	Specific / Generic antagonist(s) (V3) Type of antagonist(s) (V5) Symbolism (V10)	Are the antagonist(s) selected randomly or selectively from a target population? What is the type of the antagonist? Does the antagonist represent a symbolic value
Motivation	Possible motivation of protagonist (V1) Description of motivation of protagonist (V2)	What is the possible motive for the protagonist? Additional description of motivation for the protagonist
Means	Type of Incident (V1) Weapon sub-category (V4)	What is the type of the incident? Which weapon sub-category is used?
Modus Operandi	Level of intelligence (V1)	What is the level of intelligence that the protagonist needs to execute the incident

Table 8.1 The ESC and the variables selected for the experiment.

8.1.2 Case selection: Lone-operator incidents

Ever since the start of modern terror, the world has witnessed four waves of terrorism, starting in the 1880s and lasting until now (see Rapoport, 2004). These four waves are defined, and distributed over time[58], as follows.

1. The *Anarchist Wave* started in the 1880s and continued until the 1920s.
2. The *Anti-Colonial Wave* began in the 1920s, and lasted to the 1960s.
3. The *New-left Wave* started in the late 1960s and dissipated in the 1990s.
4. The *Religious Wave* began in 1979, and lasts until the present time.

(Rapoport, 2004).

[58] We note that the four waves of terrorism theory by Rapoport (2004) uses broad and roughly delineated timeframes. In our research we have distributed the cases according to the predominant energy of the wave, sometimes disregarding the strict delineation of the timeframes.

As Rapoport (2004) argues, the name given to each wave reflects its dominant -but not its only- feature or "predominant energy", within a given time period. In the context of this thesis, we therefore take the four waves of modern terrorism as a delineator of predominant energy, and not as much as a delineator of time. So, in the process of selecting cases for the analysis of lone-operator behaviour, we distribute the cases according to the four-wave classification by Rapoport, with time as a subordinate variable. We will analyse forty cases of lone-operator incidents. The four waves of terrorism theory by Rapoport (2004) are used to relate the cases to different political contexts. The cases are selected based upon four criteria.

1. The cases are executed by lone operators (see definition 2.4 for the definition of "lone operators").
2. The cases constitute an attack (as opposed to an attempt).
3. The selection process should achieve an even distribution over the four waves of modern terrorism, i.e., we select ten cases per wave of modern terrorism[59].
4. The cases have a significant effect or impact, either domestically or internationally.

To provide more insight for colleague expert researchers into our considerations with respect to the selection process, we refer to Appendix D. It lists 140 incidents that are considered for the research described in this chapter. All these incidents are related to lone operators (criterion 1). From the 140 incidents, 30 are to be characterised as attempts. This implies that the remaining list (after applying criterion 2) contains 110 incidents. Of this list, 40 cases are selected for close investigation, 10 cases per wave of modern terrorism (criterion 3). Next to the first three criteria, the decisive criterion is criterion 4. Here, effect and impact of the incident are weighed and compared with other cases that are selected for the same wave. With our case-selection process we aim to constitute a list that represents the *Zeitgeist* of the individual waves of the lone-operator behaviour. So, the cases can be used to explore the nature and development of lone-operator behaviour over time. Here, we remark that the 140 cases selected for the analysis of lone-operator behaviour by no means constitute an exhaustive or complete list of lone-operator terrorism.

[59] In the case-selection process, we disregarded the proportional part of the ten cases with respect to the total number of cases per wave. Appendix D lists the 140 cases that are included in the PANDORA I dataset.

8.1.3 The dataset

Good practice of scientific inquiry requires that data and methodology are documented and made public. To ensure we are able to publish about our results, we took our data of lone-operator behaviour from Wikipedia. This open-source data repository is freely available and accessible without restrictions from copyright or classification of information. By its nature, we are sure that Wikipedia contains the successful lone-operator attacks that have had a significant effect or impact (criterion 4). For further considerations on using open-source data and our approach to the constraints associated with it, we refer to subsection 6.1.2 Limitations of using open-source data.

8.1.4 Analysis of lone-operator behaviour

The analysis of our observations is based on ten selected cases of lone-operator behaviour per wave. We emphasise that these observations are to be considered as explanatory in nature. We do not claim to cover the full domain, but we use the forty cases to investigate general characteristics in the behaviour of lone operators in relation to the four waves of modern terrorism as defined by Rapoport (2004).

For convenient reading we include four tables that summarise four times ten cases that are selected (table 8.2 to 8.5). Every table represents one of the four waves of modern terrorism, and consists of ten carefully selected lone-operator incidents which satisfy the four criteria; they are presented in chronological order. Every table constitutes four columns. In the first column (marked with #) an incident is attributed a number from 1 to 40. This number is used in the discussion of our findings. In the second column a CaseID identifies the protagonist or antagonist related to the specific case. In the third column a short description of the incident is provided. The fourth column indicates the date of the incident.

In our discussion we will frequently refer to the internal structure of the ESC12 as introduced in chapter seven. For instance, the reference "*Antagonist* V5 cat 14" would refer to the 14^{th} category of the 5^{th} variable of the Elementary Scenario Component *Antagonist* (viz. the category "Private citizens & property", see section 7.6). The subsections (and tables) 7.1 to 7.11 may be consulted for additional explanation of the internal structure of the ESC12.

8.2 The ESC6 in modern terrorism

In this section, we will assess the forty cases of lone-operator terrorism as they were selected according to criteria 1 to 4. Below we will focus on (i) the ESC6, and (ii) the seventeen corresponding variables, that were introduced in table 8.1.

In the four subsections below, we will address one of the waves of modern terrorism per subsection. In subsection 8.2.1 we will focus our attention on the first wave of modern terrorism, and so on.

8.2.1 The ESC6 in the first wave of modern terrorism

According to Rapoport, modern terror begins in Russia in the 1880s where it is initiated by the Anarchist movements. Their terrorist strategy has been recorded as executing prominent officials. This strategy appeared so successful, that it rapidly was adopted by many revolutionary anti-state groups of the time frame. It created a wave of terror. With some exceptions, most terrorists of the first wave of modern terrorism tried to avoid indiscriminate attacks on civilians or non-combatants who were not related to the cause that the protagonists wished to advance (cf. Rapoport, 2004).

Table 8.2 introduces ten lone-operator incidents that are selected for the first wave of modern terrorism. (For a complete overview of the lone operator incidents that were considered, we refer to Appendix D.)

#	Case ID	Description	Date
1	Czar Alexander II	Czar Alexander II is assassinated with home made explosives, by Ignacy Hryniewiecki, a member of the revolutionary Russian party Narodnaya Volya[60].	13-03-1881
2	French president Marie Francois Sadi Carnot	After delivering a speech in Lyon Sadi Carnot, the president of France is stabbed to death by Italian anarchist Sante Geronimo who describes the assassination as a political act.	24-06-1894
3	Spanish prime-minister Antonio Canovas del Castillo	Michele Angiolillo shoots Spanish prime-minister Antonio Cánovas del Castillo dead at a thermal bath resort, seeking vengeance for the imprisonment and torture of alleged revolutionaries at the Montjuïc fortress.	08-08-1897
4	Empress Elisabeth of Austria	Luigi Lucheni stabs Empress Elisabeth, the consort of Emperor Franz Joseph I of Austria-Hungary, to death with a sharpened needle file in Geneva. Lucheni regarded the Empress to be a member of the oppressive upper class.	10-09-1898
5	King Umberto I of Italy	On a visit to Monza, King Umberto I is shot to death by the Italian-American anarchist Gaetano Bresci who seeks revenge for the Bava-Beccaris massacre in Milan.	29-07-1900
6	US president William McKinley	US born anarchist Leon Czolgosz shoots U.S. president William McKinley at point-blank range at the Pan-American Exposition in Buffalo, New York.	06-09-1901
7	Russian prime-minister Pyotr Stolypin	Russian prime-minister Stolypin is shot to death in the Kiev Opera House by Dimitri Bogrov, an anarchist and ex-agent of the secret police force of the Russian Empire.	01-09-1911
8	Spanish prime-minister Jose Canalejas	Spanish prime-minister Canalejas is shot to death by Manuel Pardiñas, a Spanish anarchist who commits suicide right after his act.	12-11-1912
9	King George I of Greece	While on an afternoon walk, King George I of Greece is shot dead at close range by Alexandros Schinas, a member of a socialist organisation who claims that the King had refused to give him money.	18-03-1913
10	President Symon Petliura of Ukraine	Head of the Ukrainian People's Republic, Petliuara is shot to death while walking in Paris by Sholom Schwartzbard a Russian Jewish anarchist and poet. Schwartzbard holds Petliuara responsible for the loss of his family in the pogroms.	25-03-1926

Table 8.2 Ten cases of lone-operator terrorism: 1880s to the 1920s.

Based on the 10 cases depicted in table 8.2, we will present our observations of the ESC (A) *Arena*, (B) *Protagonist*, (C) *Antagonist*, (D) *Motivation*, (E) *Means*, and (F) *Modus Operandi* and the seventeen corresponding variables that were selected, in the first wave of modern terrorism.

[60] We note that the assassination of Czar Alexander is -by some sources- attributed to two or three protagonists. We reiterate that, our definition of lone operators includes protagonists that work in small networks or autonomous cells, (see definition 2.4).

A: Elementary Scenario Component *Arena*

Based on the collection of the ten cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the five variables related to the Elementary Scenario Component *Arena*.

Arena V1: Region

The first wave of modern terrorism seems to centre very much on the Western world. Out of the total of ten lone-operator incidents, six (2,3,4,5,8,9)[61] take place in Western Europe (*Arena* V1 cat 8), three (1,7,10) in Russia & the Newly Independent States (NIS) (*Arena* V1 cat 12), and one (6) in North America, Canada, Mexico & United States (*Arena V1 cat 1)*. This may confirm the theory that modern terror started with the anarchist wave in France and Italy, and then spread to Eastern Europe and the new world (North America) at the turn of the nineteenth century (cf. Iviansky, 1977). However, it may also be related to an inappropriate sampling of the cases related to the first wave of modern terrorism.

Arena V4: Kill zone

Concerning the kill zone, we observe that nine (1,2,4,5,6,7,8,9,10) of the ten incidents studied, were executed in an urban environment (*Arena* V4 cat 1). In one case (3) the Kill zone was classified as rural.

Arena V5: Static location

In five incidents (2,3,5,6,7) the antagonist was attacked in a static location. In two cases (3,7) the incident occurs at a social location (*Arena* V5 cat 3), one antagonist (2) was attacked at a hotel or motel (*Arena* V5 cat 4), one (6) at a location categorised as "other" (*Arena* V5 cat 5), and in one case (5) in a location that was Unspecified (*Arena* V5 cat 7).

Arena V6: En route

In five incidents (1,4,8,9,10) out of the ten, the antagonist was en route. In four of these cases (4,8,9,10) the route was from a social to a social location (*Arena* V6 cat 2). In one case (1), the antagonist was on route from home to work or vice versa (*Arena* V6 cat 1).

[61] The numbers between brackets refer to the individual cases of lone-operator terrorism as presented in the first column of the tables 8.2 to 8.5.

Arena V7: Public route / location

With respect to the question whether the location or route was publicly known, we observe that nine (1,2,4,5,6,7,8,9,10) of the ten incidents occur in a public place (*Arena* V7 cat 1) and one incident (3) occurs in a private location (*Arena* V7 cat 2).

B: Elementary Scenario Component *Protagonist*

Based on the collection of the 10 cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the four variables related to the Elementary Scenario Component *Protagonist*.

Protagonist V1: Confirmed protagonist

All of the protagonists of the ten incidents of the first wave were known (*Protagonist* V1 cat 1).

Protagonist V6: Description of background of protagonist

We did not find a description of the background of the protagonist of the ten incidents of the first wave of modern terrorism.

Protagonist V13: Protagonist's gender

All protagonists of the ten incidents of the first wave were male (*Protagonist* V13 cat 1).

Protagonist V14: Protagonist's Age(group)

Seven out of the ten protagonists (1,2,3,4,5,6,7) were aged between twenty-one and thirty years old (*Protagonist* V14 cat 3), whereas two (8,10) protagonists were aged between thirty-one and forty (*Protagonist* V14 cat 4). One protagonist (9) was between forty-one and fifty years of age (*Protagonist* V14 cat 5).

C: Elementary Scenario Component *Antagonist*

Based on the collection of the 10 cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the three variables related to Elementary Scenario Component *Antagonist*.

Antagonist V3: Specific / Generic antagonist(s)

All antagonists of the ten incidents of the first wave of modern terrorism were selected specifically (*Antagonist* V3 cat 1).

Antagonist V5: Type of antagonist(s)

All antagonists of the ten incidents of the first wave of modern terrorism were persons (as opposed to objects). Moreover, all the antagonists belong to the category of Government (general) (*Antagonist* V5 cat 2). We distinguish: three prime-ministers (3,7,8), three presidents (2,6,10) (we included Symon Petliura, head of the Ukrainian government in exile (10) in this category), two kings (5,9), a czar (1), and an empress (4).

Antagonist V10: Symbolism

With regards to the symbolic value of the antagonists, we may conclude that two antagonists (3,6) were targeted because they represented "the elite of society" to which the anarchists fiercely opposed, while two of the antagonists (4,5) were assassinated because (from the perspective of the protagonist) they represented an oppressive regime.

D: Elementary Scenario Component *Motivation*

Based on the collection of the ten cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the two variables related to Elementary Scenario Component *Motivation*.

Motivation V1: Possible motivation of protagonist

Of the ten protagonists of the first wave of modern terrorism, six protagonists were motivated by moral outrage (3,4,5,6,9,10) (*Motivation* V1 cat 4): three protagonists claim to avenge earlier repression, torture, or massacres (3,5,10) and three protagonists (4,6,9) were motivated by hate against governments, elite, and aristocracy in general. Although the four remaining protagonists (1,2,7,8) were active in a political movement (three (2,7,8) were related to the anarchist movement, and one (1) to the left wing political party Narodnaya Volya), their motivation was, and still is unknown (*Motivation* V1 cat 6).

Motivation V2: Description of motivation of protagonist

With respect the variable Description of motivation of protagonist, we may conclude that all of the protagonists of the ten cases of the first wave were involved or in touch with a political movement. So, even though the protagonists acted as lone operators (they planned their acts without direct command from the outside), they were surrounded by a movement that shared, supported, and disseminated their anarchist principles.

E: Elementary Scenario Component *Means*

Based on the collection of the 10 cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the two variables of the Elementary Scenario Component *Means*.

Means V1: Type of incident

All of the incidents in the first wave of modern terrorism were classified as Assassination / Liquidation (*Means* V1cat1).

Means V4: Weapon sub-category

Concerning the use of weapons, we observe that seven lone-operator terrorists (3,5,6,7,8,9,10) used a handgun (*Means* V4 cat 5, Subcat c), One protagonist (1) used a self-made explosive classified as Unknown explosive category (*Means* V4 cat 6 Subcat p), one protagonist (2) used a knife (*Means* V4 cat 9, Subcat w), and one (4) used a sharp object other than knife (*Means* V4 cat 9, Subcat y).

F: Elementary Scenario Component *Modus operandi*

Based on the collection of the 10 cases of lone-operator incidents summarised in table 8.2, we observe the following with regards to the variable of the Elementary Scenario Component *Modus operandi*.

Modus operandi V1: Level of intelligence

Nine of the ten lone operators (1,2,3,4,5,6,8,9,10) only needed a low level of intelligence (*Modus operandi* V1 cat 1) to carry out their act. When this is put against the timeframe of the first wave, it may indicate that (a) targets were easy to track or follow, or (b) that information concerning the whereabouts of potential targets for assassinations was easily accessible for the protagonist. The exception is Dimitri Bogrov (7). We estimate that the ex-agent of the secret police force of the Russian Empire needed a medium level of intelligence (*Modus operandi* V1 cat 2) in order to execute his attack.

8.2.2 The ESC6 in the second wave of modern terrorism

The second wave of terrorism, which began in the 1920s, was dominated by the cause of national liberation. In this second wave, terrorism was intertwined with guerrilla warfare, such as the Viet Minh resistance against the French colonizers and the struggle of Palestine to become independent from Great Britain (cf. Rapoport, 2004).

#	Case ID	Description	Date
11	Mexican president Alvaro Obregón	Mexican president Obregón is shot in a café where he is celebrating his electoral victory. His assassin is the anti-governmental roman catholic José de León Toral. Toral blames Obregón for the Mexican government's atrocities against the Catholic Church.	17-07-1928
12	Afghan King Mohammed Nadir Shah	Afghan King Mohammed Shah is shot to death while attending a high school graduation ceremony, by a teenage boy named Abdul Khaliq,	08-11-1932
13	Peruvian president Luis Miguel Sanchez Cerro	Peruvian president Sanchez is killed when viewing recruits at Santa Beatrice racetrack by a member of a supressed political party Abelardo de Mendoza.	30-04-1933
14	Governor Huey Pierce Long	Governor Huey Long is shot to death by Dr. Carl Weiss, the son-in-law of one of his most prominent political opponents.	10-09-1935
15	Mohandas (Mahatma) Gandhi	Gandhi, the preeminent leader of Indian nationalism in British-ruled India is shot on his way to a prayer meeting by Nathuram Godse, a Hindu nationalist who is strongly opposed to Ghandi's doctrine of nonviolence.	30-01-1948
16	Politician Jorge Eliécer Gaitán	Leader of the populist movement in Colombia, and former minister Gaitán is running for the presidential elections when he is assassinated after a lunch with friends. The alleged murderer Juan Roa Sierra is killed by an enraged mob and the motives behind the killing remain unclear.	09-04-1948
17	Pakistan prime-minister Liaqat Ali Khan	Ali Khan is shot while addressing a gathering of 100,000 in Municipal Gardens, Rawalpindi, Pakistan by Saad Akbar Babrak, an Afghan national and a professional assassin. The assassination is never investigated properly.	16-10-1951
18	Nicaraguan president Anastasio Somoza Garcia	Somoza is shot to death at a campaign reception by Rigoberto López Pérez, a Nicaraguan poet and music composer. The assassin dies in a hail of bullets and little is known about his motivation.	29-09-1956
19	Guatemalan president Carlos Castillo Armas	Castillo Armas is killed while taking a stroll with his wife by Romeo Vásquez, a palace guard who was found dead a short while later. The motivations behind the killing remain unclear.	26-07-1957
20	Prime-minister Hendrik Verwoerd	Verwoerd is stabbed in the neck and chest in the House of Assembly by an uniformed parliamentary messenger Dimitri Tsafendas who claims to have been motivated by outrage for Verwoerd's racial policy.	06-09-1966

Table 8.3 Ten cases of lone-operator terrorism: 1920s to the 1960s.

Based on the ten cases depicted in table 8.2, we present our observations of the ESC (A) *Arena*, (B) *Protagonist*, (C) *Antagonist*, (D) *Motivation*, (E) *Means*, and (F) *Modus Operandi* in the second wave of modern terrorism, below.

A: Elementary Scenario Component *Arena*

Based on the data of lone-operator incidents summarised in table 8.3, we observe the following with regards to the five variables related to the Elementary Scenario Component *Arena*.

Arena V1: Region

Geographically, the second wave of lone-operator terrorism does not have its focus on one specific region. Four incidents (13,16,18,19) occurred in South America (*Arena* V1 cat 3), two incidents (11,14) took place in North America, Canada, Mexico & United States (*Arena* V1 cat 1), and two (15,17) in South Asia (*Arena* V1 cat 6). Furthermore, one incident occurred in Central Asia (*Arena* V1cat7), and one incident (20) took place in Sub-Saharan Africa (*Arena* V1cat11). This geographic distribution seems to support the idea of a colonialist wave of terror, which evidentially takes place in parts of the world that were colonised by Europe, such as South and Central America & Caribbean, Southeast Asia, and Africa.

Arena V4: Kill zone

Concerning the kill zone, we observe that nine of the ten incidents studied (11,12,13,14,15,16,17,18,20) were executed in an urban environment (*Arena* V4 cat 1). In one case (19) the environment was Unspecified (*Arena* V4 cat 3).

Arena V5: Static location

In nine of the ten incidents studied (11,12,13,14,15,16,17,18,20) the antagonist was assaulted at a static location. In five of these cases (12,13,14,17,18) the location was classified as Other (*Arena* V5 cat 5); in three cases (11,15,16), the location was classified as Social location (*Arena* V5 cat 3); in one case (20), the location was classified as Workplace (*Arena* V5 cat 2).

Arena V6: En route

In one of the ten incidents recorded for the second wave of terrorism, the antagonist was en route when he was attacked. Guatemalan president Castillo Armas (19) was on his way from a social location to a social location (*Arena* V6 cat 2).

Arena V7: Public route / location

With respect to the question whether the location or route was publicly known, we observe that in seven cases (11,12,13,15,16,17,18,19), the *Arena* was a public accessible location (*Arena* V7 cat 1) such as a street (15,16,19), a public event (12,13,17), or a restaurant (11). Out of the three cases in which the assassination did not happen in a public place (*Arena* V7 cat 2), two antagonists were executed in a parliament building (16,20), and one assassination took place in a private club (18).

B: Elementary Scenario Component *Protagonist*

Based on the collection of the 10 cases of lone-operator incidents summarised in table 8.3, we observe the following with regards to the four variables related to the Elementary Scenario Component *Protagonist*.

Protagonist V1: Confirmed protagonist

All of the protagonists of the ten incidents of the second wave were known (*Protagonist* V1 cat 1).

Protagonist V6: Description of background of protagonist

Concerning the backgrounds of the protagonists of the ten incidents of the second wave, we may conclude that two protagonists (16,20) had a history of mental problems. Juan Roa Sierra (16), the protagonist who assassinated Colombian liberal leader and presidential candidate Jorge Eliecer Gaitan, was diagnosed with schizophrenia and had illusions of "being mighty". Dmitri Tsafendas (20), who stabbed South African prime-minister Hendrik Verwoerd to death, had been hospitalised several times before the assassination due to 'irrational behaviour'.

Protagonist V13: Protagonist's gender

All protagonists of the ten incidents of the second wave were male (*Protagonist* V13 cat 1).

Protagonist V14: Protagonist's Age(group)

Congruent with the ten incidents of the first wave, all protagonists of the second wave were under fifty years of age. (In three cases (12,13,17) the variable age(group) could not be determined, but reports indicate that the protagonists were young males less than fifty-one years of age). Five of the perpetrators (11,14,16,18,19) were aged between twenty-one and thirty years old (*Protagonist* V14 cat 3). One protagonist (15) was between thirty-one and forty years old (*Protagonist* V14 cat 4), and one protagonist (20) was between forty-one and fifty years of age (*Protagonist* V14 cat 5). In the case of Shah (12), we know that the protagonist was a teenage boy, even though we do not know his exact age. In two cases (13,17) the age of the prospective protagonist could not be determined exactly, but is believed to be less than fifty.

C: Elementary Scenario Component *Antagonist*

Based on the data of lone-operator incidents summarised in table 8.3, we observe the following with regards to the three variables related to the Elementary Scenario Component *Antagonist*.

Antagonist V3:
Specific / Generic antagonist(s)
All antagonists of the ten incidents of the second wave of modern terrorism were selected specifically (*Antagonist* V3 cat 1).

Antagonist V5: Type of antagonist(s)
All antagonists of the ten incidents of the second wave of modern terrorism were persons (as opposed to objects). In nine of the ten cases (11,12,13,14,16,17,18,19,20) the antagonists belonged to the category of Government (general) (*Antagonist* V5 cat 2). Congruent with the first wave of modern terrorism, these nine antagonists were all high-profile members of the government. We distinguish four presidents (11,13,18,19), two prime-ministers (17,20), one governor/senator (14), a king (12), and a prominent politician (16). Only in the case of Mohandas Gandhi (16), the target was not part of the government (Gandhi was a prominent leader of the Indian independence movement) and was categorised as Religious figures / institutions (*Antagonist* V5 cat 15).

Antagonist V10: Symbolism
In two cases, a symbolic value was attributed to the antagonist. In the case of the assassination of Nicaraguan president Garcia (18), the poet Perez shot Garcia because he regarded him "an icon of the oppressive regime". Additionally, in the case of South Africa's prime-minister Verwoerd (20), Verwoerd was stabbed to death because the protagonist, regarded Verwoerd as "the architect of the Apartheid-regime" and held him responsible for the racist policies of the regime.

D: Elementary Scenario Component *Motivation*

Based on the data of lone-operator incidents summarised in table 8.3, we observe the following with regards to the two variables of the Elementary Scenario Component *Motivation*.

Motivation V1: Possible motivation of protagonist

The motivation of seven (12,13,14,16,17,18,19) protagonists of the ten incidents of the second wave is unknown (*Motivation* V1 cat 6). The three remaining protagonists (11,15,20) were motivated by Moral outrage (*Motivation* V1 cat 4).

Motivation V2: Description of motivation of protagonist

With regards to the description of the motivation of the protagonist, we found indications that Sierra (16) the assassin of Colombian Politician Gaitán was suspected to have been suffering from deteriorating mental health. Additionally, we found that Vásquez (19) was believed to have been paid to kill Guatemalan president Armas. (Because these conditions were not mentioned as primary motivations, we decided to classify the motivation of both these protagonists as "unknown".) Additionally, Toral (11), who shot Mexican president Obregón, was revenging the execution of two of his friends who were accused of plotting to assassinate Obregón. Godse (15) a Hindu nationalist activist was outraged by what he considered Gandhi's partiality to India's Muslims. Finally, Tsafendas (20) told the police that he killed Verwoerd because he was "disgusted with the racial policy".

E: Elementary Scenario Component *Means*

Based on the data of lone-operator incidents summarised in table 8.3, we observe the following with regards to the two variables related to the Elementary Scenario Component *Means*.

Means V1: Type of incident

All ten incidents of the second wave of modern terrorism were classified as Assassination / Liquidation (*Means* V1 cat 1).

Means V4: Weapon sub-category

With regards to the means by which the incidents were executed, we note that in nine incidents a handgun (*Means* V4 cat 5, Subcat c) was used to execute the attack (11,12,13,14,15,16,17,18,19). In the one remaining case (20), a knife (*Means* V4 cat 9, Subcat w) was used.

F: Elementary Scenario Component *Modus operandi*

Based on the data of lone-operator incidents summarised in table 8.3, we observe the following with regards to the variable of the Elementary Scenario Component *Modus operandi*.

Modus operandi V1: Level of intelligence

In seven cases (11,12,13,14,15,16,17) the level of intelligence tat was required for the protagonists, was labelled as low (*Modus operandi* V1 cat 1). In the remaining three cases (18,19,20), the level of intelligence was labelled medium (*Modus operandi* V1 cat 2). To be able to approach the antagonist unobtrusively, Perez (18) needed to infiltrate the club where Somoza held a campaign reception, Tsafendas (20) needed to infiltrate prime-minister Verwoerd's environment by being hired as a parliamentary messenger, and Vasquez Sanchez (19) needed to infiltrate president Castillo's palace guard.

8.2.3 The ESC6 in the third wave of modern terrorism

The third wave of modern terrorism, according to Rapoport (2004), was driven by the goal of social revolution and national self-assertion. The trigger event for this wave was the Viet Cong's successful resistance against the French and later the US Military in Vietnam. The third wave of modern terrorism, also referred to as the new-left wave, is characterised by a modus operandi in which terrorist groups, operating in small independent cells (such as urban guerrillas) seek to overturn the capitalist system. Examples of such groups are: the Red Brigade in Italy, the Red Army Fraction in Germany, and the Weather Underground in the US. The third wave of modern terrorism started in the late 1960s and continued until 1990. In this wave, the quest for national self-assertion was often mixed with the fight against capitalism and Western democracies (cf. Rapoport, 2004).

#	Case ID	Description	Date
21	US president John Fitzgerald Kennedy	John F. Kennedy, is travelling in a presidential motorcade in Dallas, Texas, when he is shot to death with a long range firearm. Lee Harvey Oswald was charged with the assassination of Kennedy. He denied but was killed by Jack Ruby on November 24, before he could be indicted or tried.	22-11-1963
22	President of El Salvador of Maximilliano Hernández Martinez	Hernández, is stabbed to death at age 84, by his driver Cipriano Morales whose father was one of the many executed by Hernández's dictatorship.	15-05-1966
23	Civil rights leader Martin Luther King,	Martin Luther King is shot to death with a long range firearm by James Earl Ray, while standing on the balcony of his hotel room.	04-04-1968
24	German student movement leader Rudi Dutschke	Rudi Dutschke is shot in the head, while getting on his bike by a young anti-communist Josef Bachmann. Dutschke survives the attack and dies 11 years later, reportedly because of the brain damage sustained in the assassination attempt.	11-04-1968
25	Presidential candidate Robert Francis Kennedy	Robert F. Kennedy is shot while walking through a hotel kitchen by a 24-year-old Palestinian-Jordanian Shirhan Shirhan because of the senator's advocacy of U.S. support for Israel.	05-06-1968
26	King Faisal of Saudi Arabia	King Faisal is assassinated by his cousin Prince Faisal bin Musaid while he is welcoming him in his palace in Riyadh. Prince Faysal reportedly wants to avenge the death of his brother Prince Khalid who was shot by a policeman.	25-03-1975
27	Producer Larry Flynt	Larry Flynt, American publisher of porn magazines, is shot by white-supremacist serial killer Joseph Franklin with a long range firearm, when he is leaving the court building with his lawyer, after a legal battle related to obscenity.	06-03-1978
28	Theodore Kaczynski (a.k.a. 'The Unabomber')	Theodore "Ted" Kaczynski (also known as the Unabomber (university and airline bomber) is an American mathematician, social critic and primitivist, who engages in a mail bombing spree that spans nearly 20 years, killing three people and injuring 23 others.	1978-1995
29	Joseph Christopher (a.k.a. 'The .22-Caliber Killer')	Joseph Christopher is an American serial killer known as the ".22-Caliber Killer". He kills twelve individuals and wounds numerous others in a period of eight months.	1980-1981
30	Musician John Lennon	John Lennon is shot to death by Mark Chapman, a "fan" who becomes obsessed with the musician. Upon arrest the killer states "I'm sure the big part of me is Holden Caulfield, the main character of the novel *The catcher in the Rye*.	08-12-1980

Table 8.4 Ten cases of lone-operator terrorism: 1960s to the 1990s.

In this subsection, we will assess ten cases of lone-operator terrorism of the third wave of terrorism. A brief summary of the cases that are selected from the third wave of modern terrorism is presented in table 8.4.

Based on these ten cases, we will present our observations of the six Elementary Scenario Components (A) *Arena*, (B) *Protagonist*, (C) *Antagonist*, (D) *Motivation*, (E) *Means*, and (F) *Modus Operandi* in the third wave of modern terrorism.

In the third wave of modern terrorism, we find three lone-operators that operate over a period of time, killing and injuring more than one person in the process (27,28,29). Below we will briefly summarise these three cases.

1. The first lone-operator terrorist operating over a period of time is Joseph Paul Franklin (27). Franklin confessed to ten murders, two bombings, and an attempt to kill Larry Flynt, between 1977 and 1980. Franklin stated to be motivated by the ambition to "clean the world" of people he considered inferior, especially Afro-American and Jewish people.

2. The second protagonist (and probably most well known 'lone wolf') who operated over a prolonged timeframe, is Theodore (Ted) Kaczynski also known as the "Unabomber" (28). Kaczynski engaged in a mail-bombing spree that started in 1978 and continued until 1995, when he was arrested.

3. The third lone-operator terrorist operating over a period of time is Joseph Christopher, also known as the ".22-Caliber Killer" (29). Christopher killed at least twelve individuals and injured five, from September 1980 until his arrest in May 1981.

A: Elementary Scenario Component *Arena*

Based on the collection of the ten cases of lone-operator incidents summarised in table 8.4, we observe the following with regards to the five variables related to the Elementary Scenario Component *Arena*.

Arena V1: Region

With respect to the geographic spread of the ten lone-operator incidents from the third wave, we observe that seven of the lone-operator attacks (21,23,25,27,28,29,30) occurred in North America, Canada, Mexico & United States (*Arena* V1 cat 1). The remaining three attacks took place in South America (22) (*Arena* V1 cat 3), Western Europe (24) (*Arena* V1 cat 8), and Middle East & North Africa (26) (*Arena* V1 cat 10).

Arena V4: Kill zone

All ten incidents of the third wave of modern terrorism were executed in an urban environment.

Arena V5: *Static location*

Three incidents (22,23,26) took place at a static location. One of these locations (22) was classified as Home address (*Arena* V5 cat 7), one (23) as Hotel / Motel (*Static location* V5 cat 4), and one (26) as Workplace (*Arena* V5 cat 2).

In two cases the location of the incidents was not applicable as both the cases of Theodore Kaczynski (28) and Joseph Christopher (29) encompass a series of attacks that took place at a variety of locations, over a time span of several years.

Arena V6: *En route*

In five cases (21,24,25,27,30) the antagonist was assaulted when he was *en route*. In two of those cases (21,25), the antagonist was travelling from a work related location to another work related location (*Arena* V6 cat 5), and in two instances (24,30) from a social location to a social location (*Arena* V6 cat 5). In one case (27) the antagonist was en route from home to work (or v.v.) (*Arena* V6 cat 1).

Arena V7: *Public route / location*

In the cases of Kaczynski (28) and Christopher (29), the incident encompasses various locations and were therefore classified as Not Applicable. In five cases (21,24,26,27,30) the incident occurred in a publicly accessible location (*Arena* V7 cat 1). In the remaining three cases, the location was not publicly known (*Arena* V7 cat 2). We distinguish (i) the private residence where president Hernández (22) was stabbed, (ii) the kitchen of the hotel where Robert Kennedy was shot, and (iii) the palace where King Faisal was killed.

B: Elementary Scenario Component *Protagonist*

Based on the data of lone-operator incidents summarised in table 8.4, we observe the following with regards to the four variables related to the Elementary Scenario Component *Protagonist*.

Protagonist V1: Confirmed protagonist

All of the protagonists of ten incidents of the third wave were known (*Protagonist* V1 cat 1).

Protagonist V6: Description of background of protagonist

There is a great variety in the backgrounds of the protagonists of the third wave. Four protagonists (21,23,27,30) were (high) school drop-outs, two protagonists (25,30) had physically abusive fathers (25,30) and/or visited a psychologist (21,30). Two protagonists were treated or tested by psychologists: Oswald (21) was diagnosed as having a "vivid fantasy life, focused on omnipotence and power to compensate for personal shortcomings and frustrations" as well as suffering from "a personality pattern disturbed with schizoid features and passive-aggressive tendencies"; Chapman (30), the lone operator that shot Lennon, combined several background characteristics: he was physically abused by his father; he skipped classes, was a drug abuser, became a born-again Christian, attempted to commit suicide, and was treated for clinical depression. Later in life, he developed several manic obsessions; one of those led him to believe he was Holden Caulfield.

Protagonist V13: Protagonist's gender

All the ten protagonists of the ten incidents of the third wave were male (*Protagonist* V13 cat 1).

Protagonist V14: Protagonist's Age(group)

Congruent with the ten incidents of the first wave, all protagonists were under fifty years of age. Six protagonists were between twenty-one and thirty years of age (21,24,25,26,29,30), and one was between thirty-one and forty years old (23). In one case (22) the age of the protagonist was classified as Unspecified. Because three protagonists operated over a longer period of time (27,28,29), two of them (27,28) do not fit the aforementioned age categories: Franklin (27) who attempted to assassinate Flynt at the age of twenty-seven, continued to (attempt to) kill people until the age of thirty-one. Kaczynski (28) started a mail bombing spree when he was thirty-six and continued sending mail bombs until he was fifty-two years of age.

C: Elementary Scenario Component *Antagonist*

Based on the data of lone-operator incidents summarised in table 8.4, we observe the following with regards to the three variables related to the Elementary Scenario Component *Antagonist*.

Antagonist V3: Specific / Generic antagonist(s)

Eight of the ten antagonists (21,22,23,24,25,26,27,30) of the third wave of modern terrorism were specifically selected (*Antagonist* V3 cat 1). Consequently, the two remaining protagonists, Kaczynski (28), and Christopher (29), selected their antagonists randomly from a target population, that was defined by (supposed) involvement with modern technology (28), or ethnic descent (29).

Antagonist V5: Type of antagonist(s)

All ten antagonists of the third wave of modern terrorism were persons (as opposed to objects). Moreover, the majority of the targets (23,24,27,28,29,30) was classified as Private citizens & property (*Antagonist* V5 14). Four of the antagonists (21,22,25,26) belonged to the category Government (general) (*Antagonist* V5 14) from which we distinguish: two presidents (21,22), one presidential candidate (25), and a king (26).

Antagonist V10: Symbolism

In five cases, a symbolic value was attributed to the antagonist: First, King (23) was assassinated because the protagonist thought King to be "a symbol of the Afro-American community". Second, Dutschke (24) was targeted because the protagonist believed that Dutschke represented communism and the red danger in Germany. Third, the American publisher Flynt (27) was selected because the protagonist regarded him as a symbol of the new inter-racial tolerance. Fourth, Kaczynski (28) aimed to "attract attention to the erosion of human freedom necessitated by modern technologies" and aimed his attempts at people that symbolised the abuse of modern technology. Fifth, Christopher (29) was motivated by deep pathological racism, and aimed to send a message to the African American community by targeting members of that community.

D: Elementary Scenario Component *Motivation*

Based on the data of lone-operator incidents summarised in table 8.4, we observe the following with regards to the two variables of the Elementary Scenario Component *Motivation*.

Motivation V1: Possible motivation of protagonist

In seven cases, the motivation of the protagonist was known (22,24,25,27,28,29,30). In five of these cases (22,24,25,27,29), the protagonist was motivated by Moral outrage (*Motivation* V1 cat 4), in one case (28) by Power

(*Motivation* V1 cat 3). In one incident (30) we classified the motivation of the protagonist as a craving for Glory (*Motivation* V1 cat 5). Additionally, we may conclude that in three cases (21,23,26) the motivation remains unknown (*Motivation* V1 cat 6).

Motivation V2: Description of motivation of protagonist

With regards to the description of motivation of the protagonists of the third wave, we note the following with regards to the five protagonists who were motivated by Moral outrage. Morales (22) aimed to revenge his father who was one of the many people murdered by Hernández's dictatorship. Bachmann (24) was fuelled by an intense hate of communism. Shirhan (25) assassinated Kennedy because he was outraged by the senator's advocacy of U.S. support for Israel. Franklin (27) claimed to be outraged by the racially mixed couples portrayed in the publications of his antagonist, and Christopher (29) suffered an out of control rage towards African American people. For the two protagonists that were not motivated by Moral outrage we note the following. Kaczynski (28), who we classified as being motivated by Power, tried to influence the process of scientific progress, and Chapman (30) who we classified as being motivated by Glory, stated he assassinated Lennon to obtain some of his fame and glory

E: Elementary Scenario Component *Means*

Based on the data of lone-operator incidents summarised in table 8.4, we observe the following with regards to the two variables related to Elementary Scenario Component *Means*.

Means V1: Type of incident

Nine (21,22,23,24,25,26,27,29,30) of the ten incidents in the third wave of modern terrorism were classified as Assassination / Liquidation (*Means* V1 cat 1). The incident related to Kaczynski (28) was classified as Bombing (*Means* V1 cat 3).

Means V4: Weapon sub-category

Concerning the weapon sub-category used in the incidents, we observe that in four cases (24,25,26,30) a handgun (*Means* V4 cat 5 subcat c) was the weapon of choice. In four cases, a Rifle / Shotgun was used (21,22,27, 29). In one case (22) a knife (*Means* V4 cat 9 Subcat w) was used, and in one case (28) the protagonist used a self-made explosive classified as Unknown explosive category (*Means* V4 cat 6 Subcat p) to carry out his act.

F: Elementary Scenario Component *Modus operandi*

Based on the data of lone-operator incidents summarised in table 8.4, we observe the following with regards to the variable related to the Elementary Scenario Component *Modus operandi*.

Modus operandi V1: Level of intelligence

With regards to the level of intelligence the protagonists of the ten incidents of the third wave required, we find that seven (23,24,26,27,28,29,30) of only needed a low level of intelligence (*Modus operandi* V1 cat 1). A medium level of intelligence (*Modus operandi* V1 cat 2) was required in the following two cases. First, Oswald (21) managed to get a job at the Texas School Book Depository, the location from where the shots were reportedly fired that killed John Kennedy. Second, Morales (22) had to infiltrate Martinez' inner circle and become his driver before he could execute his plan. "Unspecified" (*Modus operandi* V1 cat 4) was listed in the remaining case of the assassination of Robert Kennedy (25). From the data collected, it did not become apparent whether the protagonist Shirhan was at the scene because he infiltrated the location in advance (which would lead to a listing of "medium level of intelligence") or merely by chance.

8.2.4 The ESC6 in the fourth wave of modern terrorism

The roots of the fourth wave of modern terrorism can be traced back to the year 1979 in which the Soviet Union invaded Afghanistan. This invasion inspired the call to jihad, which led to the recruitment of mujahedeen from all over the Muslim world; which eventually resulted in the emergence of Al Qaeda. Also, the Iranian Revolution of 1979 had as outcome the establishment of a Caliphate, an Islamic theocracy, under the reign of Ayatollah Khomeini. This, in turn, caused the radicalisation of certain Shi'ite organisations in Iraq, such as al-Dawa, and particularly in Lebanon (the formation of Hizballah). The Iranian revolution and the invasion of Afghanistan by the Soviets invoked religious radicalism that justified the resort to violence. After those major events, the fourth wave of terrorism, the religious wave started and lasts until today (cf. Rapoport, 2004)[62].

[62] Here we like to refer to our previous statement (see section 8.2). The lone-operator cases in 8.2.4 are chosen from the timeframe Rapoport named "The religious wave". This does not necessarily imply that all the lone-operators mentioned were inspired by religious motivations.

In this subsection, we will assess ten cases of lone-operator terrorism of the fourth wave of terrorism. A brief summary of the cases that are selected from the fourth wave of modern terrorism is presented in table 8.5.

#	Case ID	Description	Date
31	Franz Fuchs	Between 1993 en 1997 Franz Fuchs kills four people and injures 15 against foreigners and people who were friendly to foreigners with three improvised explosive devices (IEDs) and 25 mail bombs.	1993 - 1997
32	Prime-minister of Israel Yitzhak Rabin	Rabin was assassinated when he attended a mass rally in Tel Aviv, that is held in support of the Oslo Accords, by a radical right-wing Orthodox Jew Yigal Amir, who opposed the signing of the these accords.	04-11-1995
33	David Copeland (a.k.a. the London Nail Bomber)	David Copeland, an English Neo-Nazi militant executes a 13-day bombing campaign in April 1999 aimed at London's black, Bangladeshi and gay communities that results in three deaths and more than a hundred injuries.	April 1999
34	LA Jewish Community Center Shooting	White-supremacist Buford Furrow, Jr. walks into the lobby of the North Valley Jewish Community Center and opens fire with a semiautomatic weapon. The gunfire wounds three children, a teenage counselor, and an office worker.	10-08-1999
35	Dutch politician Pim Fortuyn	Nine days before the general election in the Netherlands, Fortuyn is shot to death in a parking lot outside a radio studio. The environmental activist Volkert van der Graaf who shot him, claims that Fortuyn was using Muslims and immigrants as scapegoats in a campaign to seek political power.	06-05-2002
36	Swedish politician Anna Lindh	Anna Lindh is attacked while shopping in a department store in central Stockholm. She is stabbed in the chest, abdomen and arms. The attacker Mijailo Mijailović reportedly has serious mental problems, and has previously been convicted of violent crimes. His motive is not considered political.	11-09-2003
37	Jerusalem Bulldozer Attack	An Arab resident of east Jerusalem Hussam Taysir Duwait attacks several cars on Jaffa Road in Jerusalem using a front-end loader killing three people and wounding at least thirty pedestrians, before being shot to death. A motive for the attack cannot be determined, but police at the scene refers to the incident as a terrorist attack.	02-07-2008
38	Attack on the Dutch Royal Family	During the celebration of Queen's Day in the Netherlands, Karst Tates drives his car at high speed into a parade that includes members of the Royal Family of the Netherlands, killing eight bystanders and injuring ten people. Tates' exact motive remains unclear.	30-04-2009
39	Fort Hood shooting	On November 5th 2009, a U.S. Army major and psychiatrist Nidal Malik Hasan, fatally shot 13 people and injures more than 30 others at Fort Hood, Texas. Although Hasan does not motivate his actions, the Fort Hood shooting is considered a terrorist attack.	5-11-2009
40	Pakistani governor Salman Taseer	Taseer is shot to death by one of his bodyguards that shot him 27 times with a sub-machine gun as he is returning to his car after meeting a friend for lunch in Islamabad. His assassin Malik Qadri claims he killed Taseer because of the latter's vocal opposition to the blasphemy law in Pakistan.	04-01-2011

Table 8.5 Ten cases of lone-operator terrorism: 1990s to now.

Based on the ten cases depicted in table 8.5, we will present our observations of the six Elementary Scenario Components (A) *Arena*, (B) *Protagonist*, (C) *Antagonist*, (D) *Motivation*, (E) *Means*, and (F) *Modus Operandi* in the fourth wave of modern terrorism, below.

A: Elementary Scenario Component *Arena*

Based on the collection of the ten cases of lone-operator incidents from the fourth wave, we observed the following with regards to the five variables related to the Elementary Scenario Component *Arena*.

Arena V1: Region

With respect to the variable Region, we note that five incidents (31,33,35,36,38) occurred in Western Europe (Arena V1 cat 8), two incidents (32,37) in Central Asia (Arena V1 cat 7), and two incidents occurred in the North America, Canada, Mexico & United states (Arena V1 cat 1). One incident (40) was executed in South Asia (Arena V1 cat 6).

Arena V4: Kill zone

Nine out of the ten cases (31,32,33,34,35,36,37,38,40) took place in an urban environment. The exception is the Fort Hood shooting (39), which was executed on a military base (Fort Hood) in a rural area in Texas.

Arena V5: Static location

Seven of the incidents occurred at a static location (32,34,35,36,37,38,39). Five of these incidents (32,34,36,37,38) took place on a location classified as Social (*Arena* V5 cat 3). One incident (35) was executed at a location classified as Other (*Arena* V5 cat 5), and one (39) incident at a location classified as Work (*Arena* V5 cat 2).

Notably, two cases (31,33) are related to a series of (mail) bombing incidents. As these incidents took place at several different locations, the variables Static location and En route were classified as N.A. (Not Applicable) (*Arena* V5 cat 7).

Arena V6: En route

Only one incident of the ten selected lone-operator incidents of the fourth wave was executed while the antagonist was en route. Pakistani governor Taseer (40) was shot when he was returning home from a meeting with a friend. We classify the En route variable in this case as Home - Social (or vice versa) .

Arena V7: Public route / location

In one case (33) the incident encompasses various locations. Therefore, we have classified the variable Public route / location as Not Applicable. In seven of the cases (31,32,34,35,37,38,40), the arena was a location that was public. In other words, the protagonists knew that the antagonist was going to be at a specific location at a specific time. The exceptions are (i) the Fort Hood shooting (39), and (ii) the attack on Anna Lindh (36) in which the protagonist ran into the antagonist unpremeditated.

B: Elementary Scenario Component *Protagonist*

Based on the data of lone-operator incidents summarised in table 8.5, we observe the following with regards to the four variables related to the Elementary Scenario Component *Protagonist*.

Protagonist V1: Confirmed protagonist

As in the first three waves, all of the protagonists of the ten incidents of the fourth wave were known (*Protagonist* V1 cat 1).

Protagonist V6: Description of background of protagonist

Concerning the background of the lone-operator terrorists of the fourth wave, we note that six of the protagonists were believed to be either suffering from mental illness (33,34,35,36), or socially inept behaviour (31,34). The mental illnesses vary from obsessive-compulsive disorder (35) to passive-aggressiveness tendencies (33,36) and paranoid schizophrenia (34). Moreover, one of the protagonists of the fourth wave (31) was described as highly intelligent, two of the protagonists were classified as school drop-outs (32,33), and two as having served some time in jail (34,37).

Protagonist V13: Protagonist's gender

As in the first three waves, all of the protagonists of the ten incidents of the fourth wave were male (*Protagonist* V13 cat 1).

Protagonist V14: Protagonist's Age(group)

Three of the protagonists were aged between twenty-one and thirty years old (32,33,36), six of them were between thirty-one and forty years of age (34,35,37,38,39,40), and one was between forty-one and fifty years old (31).

C: Elementary Scenario Component *Antagonist*

Based on the collection of the ten cases of lone-operator incidents summarised in table 8.5, we observe the following with regards to the three variables of the Elementary Scenario Component *Antagonist*.

Antagonist V3: Specific / Generic antagonist(s)

With respect to the Elementary Scenario Component *Antagonist*, we observe that six of the antagonists of the fourth wave (31,33,34,37,38,39) were chosen randomly from a target population (*Antagonist* V3 cat 2). They were selected because of features such as ethnic descent (31,33,34,37), and / or sexual orientation (33), or profession (39). In the case of the Attack on the Dutch Royal family, it is unknown whether the attack was directed at the royal family or at the bystanders. However, as we assessed, in both these situations the antagonists were selected randomly from a target population.

Antagonist V5: Type of antagonist(s)

Concurrent with the previous waves of modern terrorism, all the antagonists were persons (as opposed to objects). However, the target categories differ substantially. Four antagonists (31,33,34,37) were classified as Private citizens and property (*Antagonist* V5 cat 14), three (32,38,40) as Government (diplomatic) (*Antagonist* V5 cat 14), two (35,36) as Government (general) (*Antagonist* V5 cat 2), and one (39) as Military (*Antagonist* V5 cat 4).

Antagonist V10: Symbolism

In five cases (31,33,34,37,39) a symbolic value was attributed to the Elementary Scenario Component antagonist First, the white-supremacist Franz Fuchs (31) was engaged in a mail bomb spree, targeting foreigners and people who were kind to foreigners. Second, Copeland, the London Nail Bomber (33), targeted the black, Asian, and gay community in London, viewing specific people as symbolic for the whole community. Third, Burrow, the LA Jewish Community Center (34) symbolised the Jewish community in general. Fourth, the actions by Duwait (37) were directed at the Israeli community. Fifth, Hasan (39) aimed to send a message against the American interference in Afghanistan.

D: Elementary Scenario Component *Motivation*
Based on the data of lone-operator incidents summarised in table 8.5, we observe the following with regards to the two variables related to the Elementary Scenario Component *Motivation*.

Motivation V1: Possible motivation of protagonist
In six cases (31,34,36,37,38,39) the motivation of the protagonist remains unknown (*Motivation* V1 cat 6). In three cases (33,35,40), the protagonist was motivated by Moral outrage (*Motivation* V1 cat 4), and in one case (32) the protagonist was motivated by Power (*Motivation* V1 cat 3).

Motivation V2: Description of motivation of protagonist
There appears to be a great variety in backgrounds for the protagonists of the ten incidents of the fourth wave. We have found indications that psychologists associated three of the protagonists (33,34,36) with a mental disorder. First, Copeland (33) was diagnosed with paranoid schizophrenia. Second, Furrow (34) had been treated for mental illness before he started his bombing campaign. Third, post incident tests indicated that Mijailović (36) suffered from a mental illness at the time of the killing of Lindh.

Additionally, Fuchs (31) was characterised by psychologists as "highly intelligent, but a socially inept loner". Moreover, he developed a highly paranoid thought process during the years of his bombing campaign. Amir (32) was believed to have been stimulated by political motives, as he was heavily opposed to the Oslo Accords. Duwait (37) was known to be a drug abuser and Hasan (39) was believed to have been motivated by anti-American sentiments. Of the remaining three protagonists (35,38,40) nothing has been noted in relation to this variable.

E: Elementary Scenario Component *Means*
Based on the data of lone-operator incidents summarised in table 8.5, we observe the following with regards to the two variables of the Elementary Scenario Component *Means*.

Means V1: Type of incident
Of the ten of lone-operator incidents of the fourth wave, four (32,35,36,40) were classified as Assassination / Liquidation (*Means* V1 cat 1). Of the remaining six incidents, two incidents (31,33) were classified as Bombing (*Means* V1 cat 3), two

(34,39) as Armed assaults (*Means* V1 cat 2), and two (37,38) as Vehicle attacks (*Means* V1 cat 6).

Means V4: Weapon sub-category

Concerning the Weapon sub-category used in the incidents, we observe that in three cases (32,35,39) a handgun was used (*Means* V4 cat 5 subcat c), and in two cases (34,40) an automatic weapon (*Means* V4 cat 5 subcat b). Explosives classified as Unknown explosive category (*Means* V4 cat 6 subcat p) were used in two cases (31,33). Additionally, a Vehicle (*Means* V3 cat 10) was used as a weapon in two cases (37,38), and a knife (*Means* V4 cat 9 Subcat w) was used in one incident (36).

F: Elementary Scenario Component *Modus operandi*

Based on the data of lone-operator incidents summarised in table 8.5, we observe the following with regards to the variable related to the Elementary Scenario Component *Modus operandi*.

Modus operandi V1: Level of intelligence

In eight (31,32,33,34,35,36,37,38) of the ten cases the level of intelligence was classified as low. In the case of the Ford Hood shooter (39), the level of intelligence was determined to be medium as the protagonist worked for the US military for quite some time and radicalised while working there. In the case of the assassination of Taseer (40) the level of intelligence was determined to be high as the protagonist deliberately infiltrated into Taseer's security outfit, by signing up for Pakistan's elite police and subsequently requesting to be on Taseer's security service.

8.3 Cross-wave analysis of lone-operator behaviour

In this section, the results of the four individual waves of lone-operator incidents will be accumulated in an attempt to produce general characteristics of lone-operator behaviour. We provide a cross-wave analysis of the seventeen variables that are related to the ESC6 (A) *Arena*, (B) *Protagonist*, (C) *Antagonist*, (D) *Motivation*, (E) *Means*, and (F) *Modus Operandi*.

To illustrate our cross-wave analysis of lone-operator behaviour, we include a pie chart (figure 8.6), and 11 tables (viz. table 8.7 to table 8.17). In the tables, we have included columns "W 1" to "W 4" that list the results of the individual waves of modern terrorism in percentages (in which "W 1" refers to the results of the ten incidents of the first wave). The column "W 1 – 4" refers to the sum total of the results of the forty incidents that were studied.

A: Cross-wave analysis of the Elementary Scenario Component *Arena*

Arena V1: Region

With regards to the variable Region, we introduce figure 8.6 that presents the geographical distribution of the forty cases of lone-operator terrorism that are included in the experiment.

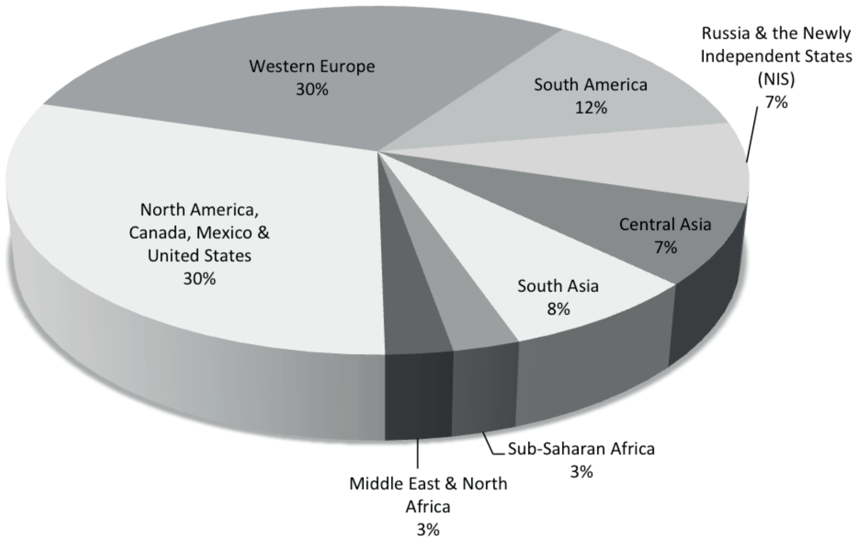


Figure 8.6 Cross-wave analysis of the ESC *Arena*.

We refrain from drawing any conclusion from the geographical distribution depicted in figure 8.6, as the sample size of the cases does not provide us with an adequate indication of the statistical significance.

Arena V4: Kill zone

With regards to the variable Kill zone we note that 92.5% of the forty incidents that are studied, occur in an urban environment (see table 8.7).

Kill zone	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 %
Urban	90	90	100	90	92.5
Rural	10	-	-	10	5
Unknown	-	10	-	-	2.5

Table 8.7 Cross-wave analysis of the variable Kill zone.

Arena V5: Static location, *Arena* V6: En route

The variables Static location and En route are closely related. An incident either occurs at a Static location, or when the antagonist was En route. (Obviously, there are cases in which these variables are categorised as Not Applicable or Unspecified). Because of the relation between these variables, we have combined them in our cross-wave analysis and in table 8.8.

Static location:	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 (%)
Home address	-	-	-	-	-
Work address	-	10	10	10	7.5
Social location	20	30	-	50	25
Hotel / Motel	10	-	10	-	5
Other	10	50	-	10	17.5
Unknown	10	-	10	-	5
Total Static location	**50**	**90**	**30**	**70**	**60**
Not Applicable	-	-	20	20	10
En route:	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 (%)
Home - work (vv.)	10	-	10	-	5
Home - social (vv.)	-	-	-	10	2.5
Work - social (vv.)	-	-	-	-	-
Work - work	-	-	20	-	5
Social - social	40	10	20	-	17.5
Unknown	-	-	-	-	-
Total En route	**50**	**10**	**50**	**10**	**30**
Total incidents	100	100	100	100	100

Table 8.8 Cross-wave analyses of the variables Static location, and En route.

With regards to the variables Static location and En route, we note that 60% of the attacks occurred while the antagonist was at a static location, while 30% of the attacks occurred while the antagonist was en route. (In four cases (10%) the protagonists were responsible for different incidents over a certain time span. In these cases the variables Static location and En route were classified as Not Applicable.)

Arena V7: Public route / location

With regards to the variable Public route / location, we observe that 70% of the forty incidents studied, occurred in a location -or on a route- that was disclosed prior to the arrival of the antagonist (this value includes known residencies or work addresses). Table 8.9 lists the results of the individual waves of modern terrorism and the average of the four waves, in percentages.

Public Route / Location	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 (%)
Public route / location	90	70	50	70	**70**
No public route / location	10	30	30	20	**22.5**
N.A.	-	-	20	10	**7.5**

Table 8.9 Cross-wave analysis of the variables Public Route / Location.

The fact that the majority of the incidents took place in a location that was easily to ascertain, provide the protagonist with the advantage of preparation. This conclusion corresponds with the findings that 70% of the protagonists only require a low level of intelligence and 30% use surveillance to anticipate their act. (See cross-wave analysis of the outlier *Modus operandi* below.)

B: Cross-wave analysis of the protagonist

Protagonist V1: Confirmed protagonist

Analysis of the data of the protagonist accumulated in the four waves of lone-operator incidents indicates that all protagonists are known.

Protagonist V6: Description of background of protagonist

We note that information on the background of a protagonist is (i) not consistently noted, and (ii) seems to be highly fuzzy in the data repository of Wikipedia. The percentages mentioned in this paragraph, include this inconsistency and fuzziness and are therefore to be read as indicative. For this reason we have (a) italicised the percentages, and (b) decided not include a separate table for the variable Description of background of protagonist. For our considerations on approaching the restrictions of open source data, we refer to subsection 6.1.2.

In the ESC12 scenario model, the variable Description of background of protagonist constitutes a text value, instead of a numeric value that may be expressed as a percentage[63]. A text value does not allow for adequate quantification. However, when we return to the texts of the data repository of Wikipedia, we note that in sixteen of the forty incidents *(40%)* a reference is made to the mental condition of the protagonist. Close examination reveals that in eight cases (20%) the lone operators appear to have been diagnosed with (or said to be suffering from) mental illnesses. In three of these cases (*37.5% of the subset of protagonists with mental illnesses*) schizophrenia is mentioned. Additionally, in seven of the forty incidents (*17.5%*) a reference is made to the fact that the protagonist is believed to be an (second generation) immigrant in the country where they perform their terrorist act. In six cases (*15%*), it is mentioned that the protagonist joined the army, and in another six cases (*15%*) that the protagonist is a (high) school drop out (cf. Van der Heide, 2011).

Protagonist V13: Protagonist's gender

Analysis of the data of the protagonist accumulated in the four waves of lone-operator incidents indicates that all protagonists were male (*Protagonist* V13 cat 1).

Protagonist V14: Protagonist's Age(group)

All the protagonists related to the forty incidents accumulated for the experiment were younger than fifty-one years old. We note that in the first wave of modern terrorism, 70% of the protagonists were aged between twenty-one and thirty years old (*Protagonist* V14 cat 3), while in the fourth wave of modern terrorism this percentage decreased to 30%.

We thus arrive at the following result: in 52.5% of the forty incidents, the protagonists are aged between twenty-one and thirty years old.

[63] In most data repositories that we studied, information on the background of a protagonist is (i) not consistently noted, and (ii) seems to be highly fuzzy. To be able to include this information in the ESC12 scenario model, we decided to create a text value for this variable (see chapter seven).

Age(group)	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 (%)
<20	-	-	-	-	-
21 -30	70	50	60	30	**52.5**
31 -40	20	10	10	60	**25**
41 -50	10	10	-	10	**7.5**
>50	-	-	-	-	
Unknown	-	30	30	-	**15**

Table 8.10 Cross-wave analysis of the variable Age(group).

C: Cross-wave analysis of the antagonist

Antagonist V3: Specific / Generic antagonist(s)

The variable Specific / Generic antagonist(s) indicates an interesting development. In the first two waves of modern terrorism, we find that none of the antagonists were chosen randomly from a target population (i.e., all the antagonists are selected specifically). In the third wave of modern terrorism, we find that 20% of the antagonists were chosen randomly from a target population. In the fourth wave this percentage increased to 60%. This development seems to confirm the theory by Schmid and Jongman (1988) that the antagonist for a modern terrorist attack is selected generically from a target population because for the symbolic relation the antagonist holds with the main target and / or with the goal of the terrorist (organisation). Table 8.11 depicts the values for the variable Specific / Generic antagonist(s).

Specific / Generic antagonist(s)	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 – 4 (%)
Specific	100	100	20	40	**65**
Generic	-	-	80	60	**35**

Table 8.11 Cross-wave analysis of the variable Specific / Generic antagonist(s).

Antagonist V5: Type of antagonist(s)

A cross-wave analysis of the Elementary Scenario Component *Antagonist* of modern terrorism indicates that in 100% of the cases the selected targets are persons – as opposed to objects (*Antagonist* V5).

We do not wish to imply that lone-operator terrorists, by definition, limit their target selection to human targets; but the percentage indicates that no other cases were included in the dataset that was used for this experiment. (For instance, the ESP PANDORA I includes an incident in which a lone operator flew a small airplane into an office of the International Revenue Service[64].) Still, it seems safe to conclude, that the vast majority of cases of lone-operator terrorism are directed against human targets.

While in the first wave, all of the targets were selected from the target population of the Government (general), this percentage dropped in the second wave to 90%, in the third wave to 40%. In the fourth wave only 20% of the selected targets belonged to the category Government (general). This development can be explained by the increase of antagonists that were selected generically, as we have described above (see *Antagonist* V3: Specific / Generic antagonist(s)). Table 8.12 depicts the values for the variable Type of antagonist(s).

Type of antagonist(s)	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 - 4 (%)
Government (general)	100	90	40	20	**62.5**
Private citizens & property	-	-	60	40	**25**
Government (diplomatic)	-	-	-	30	**7.5**
Religious figures / institutions	-	10	-		**2.5**
Military	-	-	-	10	**2.5**

Table 8.12 Cross-wave analysis of the variable Type of antagonist(s).

Antagonist V10: Symbolism

With regards to the Elementary Scenario Component *Symbolism*, we note that that the symbolic value attached to the antagonist appears to be of significant value in the process of target selection. In the analysis of the four waves of terrorism 40% of the antagonists were considered to carry a symbolic value. Table 8.13 depicts the values for the variable symbolism related to the Elementary Scenario Component *Antagonist*.

Symbolism	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 - 4 (%)
Symbolism	40	20	50	50	**40**

Table 8.13 Cross-wave analysis of the variable Symbolism.

[64] On February 18, 2010, US citizen Joseph Andrew Stack crashed a Piper PA-28 Dakota airplane into the Echelon Building in Austin, Texas. Stack wanted to attack the office of the International Revenue Service (IRS) that was housed -together with other governmental organisations- in the Echelon Building. Stack set fire to his private house before leaving for the attack, and left a note on his website stating he blamed capitalism and the IRS for his financial downfall and initiated his acts as a symbolic sacrifice for change (Extracted from the PANDORA I dataset).

D: Cross-wave analysis of the Elementary Scenario Component *Motivation*

Motivation V1: Possible motivation of protagonist

The motivation of the protagonists throughout the twentieth century appears to have changed over time, though no clear pattern can be derived from the data (cf. Van der Heide, 2011). First of all, in 50% of all cases of lone-operator acts, the motivation could not be determined. Nonetheless, moral outrage seems to be the most prevalent motivation of the protagonists throughout the four waves of modern terrorism. Table 8.14 depicts the values for the variable Possible motivation of protagonist.

Motivation	W1 (%)	W 2 (%)	W 3 (%)	W4 (%)	W 1 - 4 (%)
Moral outrage	60	30	50	30	**42.5**
Power	-	-	10	10	**5**
Glory	-	-	10	-	**2.5**
Unknown	40	70	30	60	**50**

Table 8.14 Cross-wave analysis of the variable Motivation.

Motivation V2: Description of motivation of protagonist

As with the variable Description of background of protagonist (*Protagonist* V6), descriptions about the motivations of the protagonist (i) were not consistently noted, and (ii) seem to be highly fuzzy. The percentages mentioned in this paragraph, include this inconsistency and fuzziness, and are therefore to be read as indicative. For this reason we have (a) italicised the percentages, and (b) decided not include a separate table for the variable Description of motivation of protagonist. For our considerations on approaching the restrictions of open source data, we refer to subsection 6.1.2.

According to the data published on Wikipedia we note that all of the protagonists of the first wave (*25% of all the incidents studied*) are involved or in touch with anarchist movements (this evidently might be intrinsic to the definition of "the anarchist wave"). In the second wave, in three incidents (*7.5% of all the incidents studied*) it is noted that the perpetrators might have been motivated by "communism". In another two incidents (*5% of all the incidents studied*) a reference is made to a mix of political and personal reasons. In the third wave, the motivation of three protagonists (*7.5% of all the incidents studied*) is linked to a "racial" or "white-supremacist " perspective. In the fourth wave, political reasons appear to be the main motivational factor, as in six incidents (*15% of all the* *incidents studied*) a reference is made to political reasons in general, and in three incidents (*7.5% of all the incidents studied*) to "racism" and / or "white-supremacist " tendencies.

E: Cross-wave analysis of the Elementary Scenario Component *Means*

Means V1: Type of incident

With regards to the variable Type of incident, we see a shift of type. In the first two waves all the incidents are classified as Assassination / Liquidation. In the third wave one incident is classified as a bombing. In the fourth wave of modern terrorism vehicle attacks and armed assaults are introduced. As Assassination / Liquidation implies the murder of a specially selected target, this development coincides with the shift from specifically selected antagonists, to antagonists that are selected from a general target population as explained above (see *Antagonist* V3: Specific / Generic antagonist(s)).

Overall we may conclude that a cross-wave analysis of lone operator incidents indicates that 82.5 % of the studied cases are classified as Assassination / Liquidation. Table 8.15 lists the results of the individual waves of modern terrorism and the average of the four waves, in percentages.

Type of Incident	W1 %	W 2 %	W 3 %	W 4 %	W 1 - 4 (%)
Assassination / Liquidation	100	100	90	40	**82.5**
Bombing	-	-	10	20	**7.5**
Vehicle attack	-	-	-	20	**5**
Armed assault	-	-	-	20	**5**

Table 8.15 Cross-wave analysis of the variable Type of incident.

Means V4: Weapon sub-category

With regards to the variable Weapon sub-category, we establish that there seems to be quite a variety of weapons of choice. While we may establish that our cross-wave analysis of lone-operator incidents indicates that the weapon used most often by lone operators is a handgun (in 57.5% of the cases studied), we do not discover a clear pattern in the remaining weapon sub-categories.

Weapon sub-category	W 1 (%)	W 2 (%)	W 3 (%)	W 4 (%)	W 1 - 4 (%)
Handgun	70	90	40	30	**57.5**
Rifle / Shotgun	-	-	40	-	**10**
Automatic weapon	-	-	-	20	**5**
Unknown explosive category	10	-	10	20	**10**
Knife	10	10	10	10	**10**
Sharp object other than knife	10	-	-	-	**2.5**
Vehicle	-	-	-	20	**5**

Table 8.16 Cross-wave analysis of the variable Weapon sub-category.

F: Cross-wave analysis of the Elementary Scenario Component *Modus operandi*

Modus operandi V1: Level of intelligence

In the Elementary Scenario Component *Modus operandi*, the level of intelligence of the lone-operator terrorists needed for their acts appears to be significant. We observe that in 80% of the incidents studied the protagonists only required a low level of intelligence to execute their plans. In 15% of the cases a medium level of intelligence was required and 2.5% of the attacks (only in the one case of the assassination of Taseer in which the protagonist infiltrated Taseers security outfit to be able come close to the antagonist) was executed after requiring a high level of intelligence. (In the remaining 2.5% of the cases the level of intelligence needed to carry out the attack could not be specified.)

While a cross-wave analysis seems to indicate a slight development towards a higher level of intelligence that is required by the lone operator, we do not wish to draw conclusions based on the percentages generated. Table 8.17 indicates the level of intelligence the protagonists needed for every individual wave.

Level of intelligence	W1 %	W 2 %	W 3 %	W 4 %	**W 1 - 4 (%)**
High				10	**2.5**
Medium		30	20	10	**15**
Low	100	70	70	80	**80**
Unspecified			10		**2.5**

Table 8.17 Cross-wave analysis of the variable Level of intelligence.

8.4 Answer to research question 3

In this chapter we addressed RQ3: *To what extent can a scenario model be used to analyse historic criminal behaviour?*

To answer the research question we started with a description of the research framework. We introduced (i) the six Elementary Scenario Components (ESC6), and (ii) the seventeen variables related to these components. Additionally, we explained the concept of *four waves of modern terrorism* (cf. Rapoport, 2004), which we used to define the timeframe of modern terrorism, and to divide this timeframe in four historic waves. Subsequently, we selected ten incidents of lone-operator terrorism per wave.

Next, we presented forty cases of lone-operator behaviour. They were equally distributed over the four waves of modern terrorism (i.e., we presented ten lone-operator incidents per wave). Subsequently, we identified and valued (i) the six Elementary Scenario Components, and (ii) the seventeen variables of the incidents per wave. Then we compared and contrasted the ten individual incidents per wave by analysing the communalities and differences between them.

Third, in a cross-wave analysis we accumulated the results of every wave of modern terrorism and brought together the forty cases of lone-operator terrorism in a search for specific characteristics of lone-operator behaviour. Based on our cross-wave analysis, we were able to set out an exploratory path into the world of lone-operator behaviour and make some first observations with respect to the detection of a time-independent profile of the lone-operator terrorist

From the results obtained, we may conclude (1) that the scenario model based on the Elementary Scenario Components is able to accumulate different historic criminal incidents in a systemised way, and (2) that it provides an opportunity to analyse historic criminal behaviour in general, by transcending the level of individual incidents. Moreover, we may conclude (3) that a scenario model can be used to analyse criminal behaviour to the extent that it provides contrasts and comparisons of idiosyncratic and seemingly unrelated incidents, and thus (4) it allows detection of overall characteristics.

9

NINE | Discovering PANDORA's box

Through analysis of thousands of recorded gunfights,
the Cleric has determined
that the geometric distribution of antagonists in any gun battle,
is a statistically predictable element.

Equilibrium[65]

In this chapter we will study the results of applying data-mining tools to the ESP PANDORA II and we will answer the fourth research question.

[65] Equilibrium (2002) is an American dystopian science fiction action film written and directed by Kurt Wimmer.

Modern law-enforcement agencies are faced with enormous quantities of heterogeneous data that is incongruous in nature and includes unsystematic and incomplete data. Hidden inside this data is implicit, previously unknown, and potentially useful information that can be processed and turned into actionable intelligence products (cf. Witten, Frank, & Hall, 2011). This process of extracting information from databases is called knowledge discovery in databases (KDD) or data mining.

In this chapter we will address the fourth research question of this thesis: *To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law-enforcement agencies to anticipate criminal behaviour?* We will answer this question by using the ESC12 scenario model, and try to discover "the implicit, previously unknown, and potentially useful information" that is hidden in the ESP PANDORA II. To answer the fourth research question, we evaluate and compare the results of two data-mining classifiers to the PANDORA II dataset.

In section 9.1 we elaborate on the experimental setup of the experiments. This section encompasses the process of data preparation, the data-mining classifiers that we use, and the way we interpret the results of the experiments. In Section 9.2 we describe the three experiments that we conduct. In section 9.3 we provide an overview of the results of the experiments, and in section 9.4 these results are discussed. In section 9.5 we accumulate the results of the experiments, and formulate an answer to RQ4.

9.1 Experimental setup

This section presents the setup of our experiments. It describes the process of data preparation (in subsection 9.1.1), the data-mining classifiers that we use for the experiments (in subsection 9.1.2) and the way we interpret the final results (in subsection 9.1.3).

9.1.1 Data preparation

For the experimental setup, we used the dataset of PANDORA II introduced in subsection 6.3.2. This ESP includes 98 variables and 53,289 records. In the process of data preparation, we made two assumptions.

- Assumption 1: Variables that have a value based on fewer than 10,000 records are assumed to possess insufficient power to provide us with reliable results, and are therefore excluded from the data-mining experiments.
- Assumption 2: Variables that refer to the same phenomenon are assumed to be strongly correlated by default, and therefore are excluded form the data-mining experiments.

Ad assumption 1

Of the 98 variables of the ESP PANDORA II, 76 variables had a value based on fewer than 10,000 records. According to assumption 1 the number of variables was decreased to 22.

Ad assumption 2

Typically, we assume that variables referring to the same phenomenon are strongly correlated. For instance, the variable City is obviously strongly correlated to the variable Country. To discover variables that refer to the same phenomenon (in other words variables that carry obvious correlations with other variables), a pre-test was performed by Stege (2012). For an elaborate description of this test, as well as for a discussion of its results, we refer to *Anticipating terrorism with Pandora* (Stege, 2012). The pre-test indicated an obvious correlation between six of the 22 remaining variables[66]. Therefore, applying assumption 2 on the dataset excludes another six variables from the data-mining experiments.

The application of the assumptions 1 and 2 on the PANDORA II dataset leads to a total of 16 variables that (i) have a value based on more than 10,000 records, and (ii) are not correlated by default.

As only 16 of the 98 ESC12 variables are included in the experiments that are described in this chapter, the extent of the experiments is rather limited. However, as we aim to assess whether data-mining techniques are able to enhance the

[66] We note that in the original pre-test that was performed by Stege, 7 variables were discovered that are strongly correlated by default. However, in the development of the internal structure of the ESP PANDORA II (as explained in chapter seven) several variables were combined. With respect to the subject of this chapter, 6 variables remained that are strongly correlated by default. These variables are: Region and Country, Weapon category and Weapon sub-category, Antagonist(s) die(s) from attack and Antagonist(s) die(s) from attack exact, Other fatalities and Total fatalities, Total fatalities and Total fatalities exact, Total injured and Total injured exact.

ability of the ESC12 scenario model, we confidently build our discussion on the experiments conducted with the subset of 16 variables.

Table 9.1 lists the variables that are selected for our data-mining experiments. In the first column the variables are issued by a reference number. The second column indicates the Elementary Scenario Component to which the variable is related. The third column refers to the internal structure of the ESC12 that was introduced in chapter seven (in which the reference "*Protagonist* V2" would refer to the second variable of the Elementary Scenario Component *Protagonist*). The fourth column lists the name of the variable, while the fifth column refers to the number of records that are present in the PANDORA II dataset.

Ref #	ESC	Variable	Variable name	Table	# Records
1	General info	General info V4	Successful incident	7.1	52,646
2	*Arena*	*Arena* V2	Country	7.2	52,634
3	*Time(frame)*	*Time(frame)* V2	Day	7.3	52,633
4	*Time(frame)*	*Time(frame)* V2	Month	7.3	52,633
5	*Time(frame)*	*Time(frame)* V2	Year	7.3	52,633
6	*Protagonist*	*Protagonist* V2	Number of Protagonists involved	7.5	19,922
7	*Protagonist*	*Protagonist* V15	Terrorist organisation	7.5	52,610
8	Protagonist:	*Protagonist* V20	Part of multiple-incident	7.5	51,985
9	*Protagonist*:	*Protagonist* V24	Ties with third parties	7.5	52,549
10	*Antagonist*	*Antagonist* V5	Type of antagonist(s)	7.6	52,621
11	*Antagonist*	*Antagonist* V12	Antagonist(s) die(s) from attack	7.6	52,432
12	*Antagonist*	*Antagonist* V14	Total fatalities	7.6	52,440
13	*Antagonist*	*Antagonist* V15	Total injuries	7.6	52,437
14	*Means*	*Means* V1	Type of Incident	7.9	52,449
15	*Means*	*Means* V4	Weapon sub-category	7.9	45,384
16	*Means*	*Means* V10	Suicide mission	7.9	52,440

Table 9.1 ESC12 variables included in the data-mining experiments.

9.1.2 The data-mining classifiers

In order to assess to what extent data-mining techniques (applied to the PANDORA II dataset) are able to assist law-enforcement agencies in the anticipation of criminal behaviour, data-mining classifiers are required.

In *Anticipating terrorism with Pandora II*, Stege (2012) investigated which classifier would be most suitable for our data-mining experiments. Stege performed tests with four well-known data-mining classifiers viz. ZeroR, J48 decision tree, Naïve Bayes, and K-Nearest Neighbor. For extensive reporting of these tests we refer to *Anticipating terrorism with Pandora II* (Stege, 2012). Based on her research, Stege concluded that the most suitable classifier for our experiments would be the J48 decision tree. We gratefully follow her recommendation. To be able to assess the usefulness and value of this classifier, we will compare the results of the J48 classifier with the baseline classifier ZeroR. Below we will briefly describe both the ZeroR and the J48 classifier.

ZeroR

The ZeroR classifier identifies the most common class value in a training set and returns that value when evaluating an instance (Stege, 2012). For instance, if data encompasses 55% *class A*, 40% *class B*, and 5% *class C*, then the ZeroR classifier would identify 55% of the instances correctly. Though there is no predictive power in ZeroR, it is useful for determining a baseline performance as a benchmark for other classification methods. For an extensive description of ZeroR we refer to *Anticipating terrorism with Pandora II*, (Stege, 2012).

J48 decision tree (J48)

The J48 classifier builds decision trees from a set of labelled training data, using the concept of information entropy (cf. Vanderlooy, 2009). It uses the fact that each feature of data can be used to make a decision by splitting the data into smaller subsets, one subset for every value (or range of values) of the feature. The splitting procedure stops if all variables in a subset belong to the same class. The complexity (depth) of a decision tree may be reduced by removing sub-trees and replacing them by leaves. Subsequently, the decision tree removes sections of the tree that provide little power to classify instances (Vanderlooy, 2009). For an extensive description of J48 decision tree we refer to *Anticipating terrorism with Pandora II*, (Stege, 2012).

9.1.3 Interpretation of the results

Below, we interpret the success of the classifiers by generating and comparing the accuracy and significance of the generated results.

Accuracy

The level of success of the classifiers will be determined by the proportion of successful hits, i.e., the accuracy of the outcome. We note that there is a correlation between the accuracy of the classifier and the categorical range of the variable. For instance, the categorical range of the variable *Day* consists of a number between 1 and 31, while the variable *Month* consists of a number between 1 and 12. Consequently, the accuracy results of the variable *Day* will most probably be less accurate than the results of the variable *Month*.

To provide a categorical and range-independent interpretation of the results of the three experiments, we will juxtapose the outcome of the J48 algorithm to that of the ZeroR baseline classifier.

Significance

To be able to assess the significance of the outcomes of the first two experiments, Stege (2012) performed a 5-fold cross-validation for each classifier to determine to what extent the unknown variables can be traced from the known variables. Moreover, in order to determine whether the differences in accuracies are significant, she performed a one-way ANOVA with a Tukey HSD post-hoc test in SPSS (significance level >.05). For an extensive report on these tests and their results, we refer to *Anticipating terrorism with Pandora II* (Stege 2012). We will use the outcome of the tests in subsections 9.2.1 and 9.2.2 when we refer to the significance of the results of the classifiers.

To assess the significance of the third experiment, we will compare the results of each classifier to a test set and analyse the results based on the proportion of successful hits (see 9.2.3).

9.2 Three experiments

To approach RQ4, we conduct three different data-mining experiments that represent situations in which law-enforcement agencies are required to (1) learn from, (2) adapt to, and (3) anticipate criminal behaviour. (For an explanation of the ability to learn, to adapt, and to anticipate, we refer to subsection 2.5.1, 5.2.1, 5.2.2, and 5.2.3 respectively.) Below we will describe the three data-mining experiments in detail.

9.2.1 The first experiment: Learning

In the first experiment, we test to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of learning from criminal behaviour. The experiment is based on a situation in which law-enforcement agencies are investigating a terrorist attack that recently occurred. In the process of investigation, law-enforcement agencies have to combine their knowledge of the case that is currently under investigation, with "readily accessible lessons from history" (see definition 2.5: learning). For an explanation of the value of the ability to learn, we refer to section 2.5 and subsection 5.2.1.

In the design of the first experiment we assume that in the hours after a terrorist attack, thirteen of the sixteen ESC12 variables are (or become) known. Here we mention that a known variable is equivalent to a variable with a value of which the accuracy is 100%.

The known variables are: *Successful incident* (1), *Country* (2) of the attack, *Day* (3), *Month* (4), and *Year* (5) of the attack. Furthermore, we assume that (shortly after the incident) it is known if the attack was *Part of a multiple-incident* (8), what the *Type of antagonist(s)* (10) was, and whether *Antagonist(s) die(s) from attack* (11). With respect to the victims, we assume that shortly after the incident the *Total fatalities* (12) are known, as well as the *Total injuries* (13). Finally, we assume that the *Type of incident* (14) is known, as well as the *Weapon sub-category* (15) that was used and whether the attack could be classified as a *Suicide mission* (16).

Consequently, we assume that the remaining three unknown variables (viz. *Number of protagonists* (6), *Terrorist organisation* (7), and *Ties with third parties* (9)) would provide valuable information for law-enforcement agencies in the investigation of a terrorist attack that recently occurred.

In the first experiment, we aim to generate and compare the accuracy percentages of both the ZeroR and the J48 classifier in predicting the outcome of the three unknown variables.

Table 9.3 provides an overview of the variables that are included in the first experiment. It indicates the 13 variables that are assumed to be known (√), and the 3 variables that are assumed unknown (X).

Ref #	Variable	Known (√)	Unknown (X)
1	Successful incident	√	
2	Country	√	
3	Day	√	
4	Month	√	
5	Year	√	
6	Number of protagonists		X
7	Terrorist organisation		X
8	Part of multiple-incident	√	
9	Ties with third parties		X
10	Type of antagonist(s)	√	
11	Antagonist(s) die(s) from attack	√	
12	Total fatalities	√	
13	Total injuries	√	
14	Type of incident	√	
15	Weapon sub-category	√	
16	Suicide Mission	√	

Table 9.2 Variables included in the first experiment.

9.2.2 The second experiment: Adapting

In the second experiment, we test to what extent data-mining techniques, applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of adapting to a developing criminal behaviour. The experiment is based on the situation in which law-enforcement agencies are facing an active threatening situation in which a strategic location (e.g., parliament or court building), scheduled event (e.g., the Olympic games), or important person (e.g., political leader) needs to be protected from a possible (terrorist) attack. In the process of adaptation, developing criminal behaviour needs to be managed in order to obstruct or evade the progress of that behaviour (see definition 2.6: adapting). For an explanation of the value of the ability to adapt, we refer to section 2.5 and subsection 5.2.2.

For this experiment, we assume that of the sixteen variables, six are known in advance while ten variables remain unknown. First, we assume that the attack is going to be a (1) *Successful incident*. Second, we assume that the variables *Country* (2), *Day* (3), *Month* (4), and *Year* (5) of the event are known. Finally, we assume that the *Type of antagonist(s)* (10) is known in advance (e.g., the court building, the Olympic games, or the political leader that needs to be protected).

Consequently, we try to determine to what extent the ten unknown variables can be derived from the six known variables mentioned above. The unknown variables are: *Number of protagonists* (6), *Terrorist organisation* (7), *Part of multiple-incident* (8), *Ties with third parties* (9), *Antagonist(s) die(s) from attack* (11), *Total fatalities* (12), *Total injuries* (13), *Type of incident* (14), *Weapon sub-category* (15), and *Suicide mission* (16).

Table 9.3 provides an overview of the variables included in the second experiment. It indicates the six variables that are assumed to be known (√), and the ten variables that are assumed to be unknown (X).

Ref #	**Variable**	Know (**√**)	Unknown (**X**)
1	Successful incident	√	
2	Country	√	
3	Day	√	
4	Month	√	
5	Year	√	
6	Number of protagonists		X
7	Terrorist organisation		X
8	Part of multiple-incident		X
9	Ties with third parties		X
10	Type of antagonist(s)	√	
11	Antagonist(s) die(s) from attack		X
12	Total fatalities		X
13	Total injuries		X
14	Type of incident		X
15	Weapon sub-category		X
16	Suicide Mission		X

Table 9.3 Variables included in the second experiment.

In the second experiment, we aim to generate and compare the accuracy percentages of both classifiers to predict the outcome of the ten unknown variables.

9.2.3 The third experiment: Anticipating

In the third experiment, we test to what extent data-mining techniques, applied to the ESP PANDORA II, are able to assist law-enforcement agencies in anticipating future terrorist attacks. Hence, we assume that of the sixteen variables, all sixteen are unknown (see table 9.4). The experiment represents a situation in which law-enforcement agencies can proactively engage a possible terrorist attack that might take place in the future, and "make decisions concerning future events in a timely and effective fashion, based on the interpretation of past events" (see definition 2.7: anticipating). For an explanation of the value of the ability to anticipate, we refer to section 2.5. and subsection 5.2.3.

To be able to assess the ability of the ESC12 scenario model to anticipate terrorist incidents that may happen in the future, we divided the data of the ESP PANDORA II into a training set and a test set. First, we trained the classifiers on the basis of a training set, which included all incidents from PANDORA II that occurred before 2007. Subsequently, we used the classifiers to generate accuracy percentages of the test set that included the remaining incidents that are dated from 2007 until 2010. To value the results from the third experiment, we compare the accuracy of J48 algorithm with that of the ZeroR baseline.

Ref #	**Variable**	Known (**√**)	Unknown (**X**)
1	Successful incident		X
2	Country		X
3	Day		X
4	Month		X
5	Year		X
6	Number of protagonists		X
7	Terrorist organisation		X
8	Part of multiple-incident		X
9	Ties with third parties		X
10	Type of antagonist(s)		X
11	Antagonist(s) die(s) from attack		X
12	Total fatalities		X
13	Total injuries		X
14	Type of incident		X
15	Weapon sub-category		X
16	Suicide Mission		X

Table 9.4 Variables included in the third experiment.

In the third experiment, we aim to generate and compare the accuracy percentages of both classifiers to predict the outcome of the ten unknown variables.

9.3 Results

The results described below are generated by the data-mining tool Weka[67], version 3-6-6 for Mac. For a detailed explanation of Weka we refer to Witten, Frank & Hall (2011). To conduct the experiment, we converted the PANDORA II dataset to a CSV (comma separated value) file. Because the original file was too large to open in OpenOffice, we limited the number of records by using the cases from the year 1991 until the year 2010. This reduced the total number of records of PANDORA II to 53,288. Next, we implemented the dataset into Weka, and selected the two classifiers described before (viz. ZeroR and the J48 decision tree).

To assess the accuracy for the results of the first two experiments, we performed a five-fold cross-validation. In a five-fold cross-validation the dataset is randomly partitioned into five equal size subsamples (five partitions of 20% of the dataset). A single partition of the subsample is retained as the validation data, and the remaining four subsamples (80% of the dataset) are used as training data. The cross-validation process is then repeated five times (five folds), with each of the five subsamples used exactly once as the validation data. Subsequently, the five results from the folds are averaged to produce a single accuracy value.

For the third experiment, we split the data into a training set and a test set (see subsection 9.2.3). Consequently, we could not perform a five-fold cross-validation. Therefore, to assess the accuracy for the results of the third experiment we analysed the results based on the proportion of successful hits.

For a detailed explanation of the parameters of the three tests, we refer to *Anticipating terrorism with Pandora* (Stege, 2012).

In this section we will provide the results that were collected in the three data-mining experiments announced in section 9.2. The results of the first experiment are presented in subsection 9.3.1, the results of the second experiment in subsection 9.3.2, and the results of the third experiment are presented in subsection 9.3.3. The discussion of the results will be the subject of section 9.4.

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[67] Weka is a popular suite of machine learning software written in Java, developed at the University of Waikato, New Zealand.

9.3.1 Results of the first experiment

As was explained in 9.2.1, the first experiment is based on a situation in which a law-enforcement agency is investigating a terrorist attack that recently occurred. As we assumed, in such a situation thirteen of the sixteen ESC12 variables are to be known. Moreover, we assumed that the three unknown variables (viz. *Number of protagonists*, *Terrorist organisation*, and *Ties with third parties*) would provide valuable information for law-enforcement agencies in the process of learning from criminal behaviour (see subsection 9.2.1).

Table 9.5 displays the accuracy percentages that were generated by each data-mining classifier (viz. ZeroR and J48) for the three variables that were assumed to be unknown in the first experiment[68].

Ref #	**Unknown variable**	ZeroR %	J48 %
6	Number of protagonists	30.98	40.50
7	Terrorist organisation	6.80	68.52
9	Ties with third parties	6.81	68.40

Table 9.5 Accuracy results (in percentages) of the first experiment.

With respect to the accuracy percentages of both classifiers, we make two observations.

1. For all three unknown variables, the J48 generates a result that is significantly[69] higher than the baseline classifier ZeroR.
2. The results that are generated by the J48 classifier for the variables *Terrorist organisation* and *Ties with third parties*, have improved substantially in comparison to the results of the baseline classifier.

The results of this experiment, and the extent to which data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of *learning* from criminal behaviour, will be discussed in subsection 9.4.1.

[68] Because there were many missing values in the dataset for the three unknown attributes *Number of protagonists*, *Terrorist group* and *Ties with third parties* (see subsection 6.3.2), we performed the experiment for these variables without the missing values.

[69] To assess whether the differences in the accuracies of both classifiers are significant, we performed a one-way ANOVA (ANalysis Of VAriance) with a Tukey HSD post-hoc test in SPSS (significance level >.05). For a more detailed explanation of these tests and its parameters, we refer to *Anticipating terrorism with Pandora* (Stege, 2012).

9.3.2 Results of the second experiment

As was explained in 9.2.2, the second experiment is based on a situation in which a law-enforcement agency is facing the threat of an actual terrorist attack against a person or object. As we assumed, in such a situation six of the sixteen ESC12 variables are known. Moreover, we assumed that the ten unknown variables (viz. *Number of protagonists*, *Terrorist organisation*, *Part of multiple incident*, *Ties with third parties*, *Antagonist(s) die(s) from attack*, *Total fatalities*, *Total injuries*, *Type of incident*, *Weapon sub-category*, and *Suicide mission*) provide valuable information for law-enforcement agencies in the process of *adapting* to a developing criminal behaviour (see subsection 9.2.2).

Table 9.6 displays the accuracy results that were generated by each data-mining classifier (viz. ZeroR and J48) for the ten variables that were assumed to be unknown in the second experiment[70],[71].

Ref #	Unknown variable	ZeroR %	J48 %
6	Number of protagonists	30.98	35.96
7	**Terrorist organisation**	**6.80**	**67.53**
8	Part of multiple-incident	93.59	86.10
9	**Ties with third parties**	**6.81**	**67.62**
11	Antagonist(s) die(s) from attack	88.12	50.09
12	Total fatalities	51.10	51.00
13	Total injuries	55.94	59.44
14	Type of incident	59.19	44.31
15	Weapon sub-category	48.32	25.05
16	Suicide Mission	95.88	96.57

Table 9.6 Accuracy results (in percentages) of the second experiment.

With respect to the accuracy percentages of both classifiers, we make three observations.

1. The results that are generated by the J48 classifier for the variables *Part of multiple incident*, *Antagonist(s) die(s) from attack*, *Total fatalities*, *Total injuries*, *Type of incident*, and *Weapon sub-category*, are lower than the baseline classifier.

[70] Because there were many missing values in the dataset for the three unknown attributes, *Number of protagonists*, *Terrorist group*, and *Ties with third parties* (see subsection 6.3.2), we performed the experiment for these variables without the missing values.

[71] We note that the results published in the thesis *Anticipating terrorism with Pandora II* (Stege, 2012) contain slight inaccuracies. In our discussion (and in table 9.6) we corrected these errors, and present the current results from the original experiments executed by Stege (2012).

2. The results that are generated by the J48 classifier for the variable *Number of protagonists* and *Suicide mission* have improved slightly in comparison to the results of the baseline classifier.
3. The results that are generated by the J48 classifier for the variables *Terrorist organisation* and *Ties with third parties*, have improved significantly in comparison to the results of the baseline classifier[72].

For convenient reading, we have marked the two variables that generate an accuracy percentage that is substantially better than the baseline classifier in table 9.6, in bold.

Notably, in the second experiment the J48 classifier generates accuracy percentages that are lower than the ZeroR classifier for five of the ten unknown variables (viz. *Part of multiple-incident*, *Antagonist(s) die(s) from attack*, *Total fatalities*, *Type of incident*, and *Weapon sub-category*). Additionally, the accuracy results generated for three of the ten unknown variables are only slightly higher than the ZeroR classifier (viz. *Number of protagonists*, *Total Injuries*, and *Suicide mission*). This outcome may be explained by the setup of the second experiment, in which six known variables are used to identify correlations relevant to the ten unknown variables. In other words, the J48 builds its decision tree on fewer data than it did in the first experiment, and it is feasible that the known variables do not contain enough predictive value to draw conclusions from. The fact that the ZeroR outperforms the J48 classifier for five of the ten unknown variables, might be explained by the fact that J48 is trying to generate a reasoning (by drawing on only six variables) while the ZeroR classifier simply identifies the most common class value.

The results of the second experiment, and the extent to which data-mining techniques, applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of adapting to a developing criminal behaviour, will be discussed in subsection 9.4.2.

[72] To assess whether the differences in the accuracies of both classifiers are significant, we performed a one-way ANOVA (ANalysis Of VAriance) with a Tukey HSD post-hoc test in SPSS (significance level >.05). For a more detailed explanation of these tests and its parameters, we refer to *Anticipating terrorism with Pandora* (Stege, 2012).

9.3.3 Results of the third experiment

As was explained in 9.2.3, the third experiment is based on a situation in which a law-enforcement agency can pro-actively engage a possible terrorist attack that might take place in the future. In such a situation, we assumed that none of the sixteen ESC12 variables are known, and that all variables would provide valuable information for law-enforcement agencies in the process of anticipating criminal behaviour (see subsection 9.2.3).

Because the third experiment is performed with a training set and a test set (see subsection 9.2.3), we could not determine significance levels. Therefore, to avoid any discussion on differences in accuracy percentages that are insignificant, we have decided to discard differences in accuracy results that are less than 10 percentage points. Obviously, this percentage is chosen arbitrarily. Table 9.7 displays the accuracy results that were generated by each classifier (viz. ZeroR and J48) for the five variables of which the in accuracy values differ more than 10 percentage points[73].

Ref #	Unknown variable	ZeroR %	J48 %
2	Country	2.59	46.26
7	Terrorist organisation	2.50	83.92
9	Ties with third parties	2.50	68.40
14	Type of incident	53.51	77.90
15	Weapon sub-category	15.23	45.20

Table 9.7 Accuracy results (in percentages) of the third experiment.

With respect to the accuracy percentages of both classifiers, we make the following observation.

1. For all five unknown variables (in which the difference in accuracy percentages between both classifiers is more than 10 percentage points), the J48 generates a result that is significantly[74] higher than the baseline classifier ZeroR.

[73] Because there were many missing values in the dataset for the three unknown attributes, *Number of protagonists*, *Terrorist group* and *Ties with third parties* (see subsection 6.3.2), we performed the experiment for these variables without the missing values.

[74] To assess whether the differences in the accuracies of both classifiers are significant, we performed a one-way ANOVA (ANalysis Of VAriance) with a Tukey HSD post-hoc test in SPSS (significance level >.05). For a more detailed explanation of these tests and its parameters, we refer to *Anticipating terrorism with Pandora* (Stege, 2012).

The results of the third experiment, and the extent to which data-mining techniques, applied to the ESP PANDORA II, are able to assist law-enforcement agencies in anticipating future terrorist attacks, will be discussed in subsection 9.4.3.

9.4 Discussion

In this section we will discuss the results of the three experiments. In subsection 9.4.1 we discuss the results of the first experiment in which we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of *learning* from criminal behaviour. In subsection 9.4.2 we discuss the results of the second experiment in which we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of *adapting* to criminal behaviour. In subsection 9.4.3 we discuss the results of the third experiment in which we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in in the process of *anticipating* to developing criminal behaviour. We will complete every subsection by a summary of the results of the experiment, and by providing a conclusion.

In our discussion we will first deal with the difference in results between the classifiers ZeroR (that we use as baseline) and J48. Subsequently, we will reflect on the decisions that are considered by the J48 decision tree.

Anticipating these reflections, we would like to emphasise that from the data in our experiments, the J48 classifier generated rather complex decision trees that sometimes did not generalise well when related to the results of the training data. Since we aim to assess the value of data-mining techniques in general, rather than the process of classification by the J48 classifier, we will mainly reflect on interpreting the decisions by the J48 decision tree. To that avail, we will simplify the outcome of the J48 decision tree by listing the respective variables that were considered. Next, we will try to interpret these variables from a law-enforcement perspective in an attempt to weigh and assess the accuracy percentages that result from the J48 decision process. We emphasise that these interpretations are to be considered as explanatory in nature, not as conclusive statements.

In our discussion we will frequently refer to the internal structure of the ESC12 that was introduced in chapter seven. For instance, the reference "*Antagonist* V5 cat 14" would refer to the 14th category of the 5th variable of the Elementary Scenario Component *Antagonist* (viz. the category "Private citizens & property", see section 7.6). The subsections (and tables) 7.1 to 7.11 may be consulted for additional explanation of the internal structure of the ESC12.

9.4.1 Discussion of the first experiment

With the first experiment, we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of learning from criminal behaviour. The experiment is based on a situation in which law-enforcement agencies are investigating a terrorist attack that recently occurred. In the process of investigation, law-enforcement agencies have to combine their knowledge of the case that is currently under investigation, with "readily accessible lessons from history" (see definition 2.5: learning).

In the design of the first experiment we assume that in the hours after a terrorist attack, thirteen variables are, or become, known. (For a list of these variables we refer to table 9.2.) Consequently, we assume that the remaining three unknown variables may offer valuable information for the law-enforcement agencies that are investigating the terrorist attack. Moreover, we assume that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in learning from criminal behaviour.

The unknown variables (UV) in the first experiment are:

- UV1: *Number of protagonists*
- UV2: *Terrorist organisation*
- UV3: *Ties with third parties*

Below we discuss these three unknown variables. For convenient reading we will reproduce the appropriate row of table 9.2 (viz. reference number 6, 7, and 9), before discussing the results of the experiment.

Below, in our discussion of the unknown variables (viz. UV1, UV2, and UV3),

- we display only the variables that contributed to the J48 decision tree (i.e., the possible correlations between the variables that were not considered by the J48 decision tree, are neither noted nor discussed),
- we display these variables in the order in which they were considered by the J48 decision tree (for convenient reading -and to avoid confusion with the reference numbers issued to the unknown variables (viz. UV1, UV2, and UV3)-, we assign these variables a character (A) to (F)).

UV1: Number of protagonists

Variable	ZeroR	J48
Number of protagonists	30.98	40.50

The J48 decision tree produces a higher accuracy percentage (40.50%) for the variable *Number of protagonist* than the baseline classifier (30.98%); the difference being 9.52 percentage points. This result is attained by a decision tree that considers the following six variables respectively.
(A) *Suicide Mission*
(B) *Country*
(C) *Type of antagonist(s)*
(D) *Weapon sub-category*
(E) *Part of multiple-incident*
(F) *Total injuries.*
Below we will briefly discuss the correlation between *Number of protagonists* and these six variables.

A: *Suicide mission*
On the basis of the data accumulated in the ESP PANDORA II the J48 decision tree suggest a correlation between the variables *Number of protagonists* and *Suicide Mission.* This correlation seems plausible given the fact that most suicide attacks are carefully planned and orchestrated by a larger number of protagonists (larger than one), in order to achieve the most effect.

B: *Country*

A possible explanation for the influence of the variable *Country* is that the data accumulated in the ESP PANDORA II indicate a relation between certain countries and the number of protagonists. This might be due to the fact that lone-operator attacks relatively frequently take place in certain western countries. In contrast, data in the ESP PANDORA II suggests that in countries with, for instance a (civil) war, attacks are generally executed by a larger number of protagonists than average.

C: *Type of antagonist(s)*

The relation between *Number of protagonists* and *Type of antagonist(s)* may be explained by the fact that certain target types require a specific amount of protagonists. For instance, "Military" type targets (*Antagonist* V5 cat 4) usually require a large(r) number of protagonists in order to be successful (see section 7.6).

D: *Weapon sub-category*

The correlation between the variables *Number of protagonists* and *Weapon sub-category*, may be best explained by an example: If the *Weapon sub-category* is "Hands, feet, fists" (*Means* V4 cat 9, Subcat v), then the number of protagonists is usually relatively small. Consequently, if the *Weapon sub-category* is "Radiological" (*Means* V4 cat 3), or "Nuclear" (*Means* V4 cat 4), this is a strong indicator that more than one protagonist is involved (see section 7.9).

E: *Part of multiple-incident*

The variable *Part of multiple-incident* holds a rather obvious relation to *Number of protagonists*. It indicates that the majority of the cases in the ESP PANDORA II that constitute multiple-incidents, are related to more (than one) protagonist(s). It seems obvious that for multiple-incidents to happen at the same time, more protagonists are required.

F: *Total injuries*

The fact that the J48 decision tree of the variable *Number of protagonists* considers the variable *Total injuries*, indicates that the number of protagonists and the number of injuries are related. This may be explained by the probable assumption that two protagonists (with weapons from a certain *Weapon sub-category*) can generate more injuries than one protagonist (with the same weapon).

UV2: Terrorist organisation

Variable	ZeroR	J48
Terrorist organisation	6.80	68.52

For the variable *Terrorist organisation* the J48 algorithm seems to produce a considerably higher accuracy percentage (68.52%) than the baseline (6.80%); the difference being 61.72 percentage points. This result is attained by a decision tree that considers the following four variables respectively.
(A) *Country*
(B) *Type of antagonist(s)*
(C) *Year*
(D) *Part of multiple-incident*.
Below we will briefly discuss the correlation between *Number of protagonists* and these four variables.

A: Country,
The correlation between the variables *Terrorist organisation* and *Country* confirms the notion of counter-terrorism organisations that terrorist organisations operate in a geographically confined area (which do not necessarily have to be their "home-countries").

B: *Type of antagonist(s)*
The J48 decision tree indicates a correlation between the variables *Terrorist organisation* and *Type of antagonist(s)*. This correlation may be best explained by an example: The three most classified types of antagonist concerning terrorist organisations are (1) Corsican National Liberation Front which exclusively aims at types of antagonist classified as "Government (general)" (*Antagonist* V5 cat 2), (2) Hizbul Mujahideen which primarily aims at types of antagonist classified as "Military" (*Antagonist* V5 cat 4), and (3) the Muttahida Qami Movement which aims at types of antagonist classified as "Private citizens & property" (*Antagonist* V5 cat 14).

C: *Year*
The J48 decision tree of the variable *Type of antagonist(s)* indicates that terrorist organisations are active within a certain timeframe. An actual example from the

data in the ESP PANDORA II that exemplifies this correlation may be found in the Communist Party of India Maoist (CPI-M). CPI-M was active in the years 2009 and 2010, but since 2011 no more incidents were recorded for this terrorist organisation. In passing, we remark that this interpretation is supported by the four waves of modern terrorism theory by Rapoport (2004).

D: *Part of multiple-incident*

On the basis of the data accumulated in the ESP PANDORA II, the J48 decision tree correlates the variables *Terrorist organisation* and *Part of multiple-incident*. This concurs with the prominent notion of counter terrorism organisations. In this notion, a specific tactic (such as organising a terrorist attack around multiple incidents) is closely related to certain terrorist organisations.

UV3: Ties with third parties

Variable	ZeroR	J48
Ties with third parties	6.81	68.40

The J48 algorithm produces a notably higher accuracy percentage (68.40%) for the variable *Ties with third parties* than the ZeroR classifier (6.81%); the difference being 61.59 percentage points. This result is generated by a decision tree that considers five variables.

(A) *Country*,

(B) *Type of antagonist(s)*

(C) *Year*

(D) *Antagonist(s) die(s) from attack*

(E) *Part of multiple-incident*

Below we will briefly discuss on the correlation between *Ties with third parties* and these five variables.

A: Country, B: *Type of antagonist(s)*, C: *Year*

The first three "leaf nodes" of the decision tree generated for UV3 (Ties with third parties) are the same as in the decision tree we have discussed under UV 2 (Terrorist organisation). Therefore, we refer to UV2 for the discussion of the variables *Country*, *Type of antagonist(s)*, and *Year* in the decision process.

D: *Antagonist(s) die(s) from attack*,
The correlation between the variable *Ties with third parties* and the variable *Antagonist(s) die(s) from attack* may be explained by the fact that the Modus operandi of the terrorist organisation and the parties they are related with, are closely correlated. In other words, terrorist organisations which are associated with one another, frequently use a similar Modus operandi in which the antagonist often dies from an attack.

E: *Part of multiple-incident*.
In congruence with the variable *Antagonist(s) die(s) from attack* discussed above, the correlation between the variable *Ties with third parties* and *Part of multiple-incident* may be explained by the fact that the Modus operandi of the terrorist organisation and the parties they are related with, are correlated.

Concluding the first experiment
With the first experiment, we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in in the process of *learning* from criminal behaviour. In the setup of the experiment, we assumed that right after a terrorist attack, the three unknown values *Number of protagonists*, *Terrorist organisation*, and *Ties with third parties* offer added value in the process of learning from criminal behaviour (see table 9.2). Moreover, we assumed that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in learning from criminal behaviour.

The accuracy value that were generated by the first data-mining experiment show that for all the three unknown variables, the J48 classifier produced accuracy percentages that are significantly higher than those generated by the ZeroR baseline classifier (see table 9.4). Therefore, we tentatively conclude that data-mining techniques may give preference in the ordering of the unknown variables to a high degree of accuracy. This ordering may subsequently help criminal investigators and analysts, to learn from historic criminal behaviour.

Therefore, based on the results of the first data-mining experiment, we may conclude that data-mining techniques applied to the ESP PANDORA II, (a) enhance the accuracy of the ESC12 scenario model, and (b) are therefore able to assist law-enforcement agencies in in the process of learning from criminal behaviour.

9.4.2 Discussion of the second experiment

With the second experiment, we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of *adapting* to criminal behaviour. This experiment is based on a situation in which law-enforcement agencies are facing the threat of an actual terrorist attack against a person or object. In the process of adaptation, law-enforcement agencies have to take appropriate action to deal with developing criminal behaviour (see definition 2.6: adapting).

In the design of the second experiment we assume that in such a situation, six variables are (or become) known (for a list of these variables we refer to table 9.3.).

Consequently, we assume that the remaining ten variables might provide valuable information for law-enforcement to take appropriate action to deal with developing criminal behaviour. Moreover, we assume that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in adapting to developing criminal behaviour.

In subsection 9.3.2 we have indicated that for two of the ten unknown variables the results of the J48 are the substantially higher as the ZeroR classifier. These variables are:

UV1: *Terrorist organisation*
UV2: *Ties with third parties*

Below we discuss only these two unknown variables. For convenient reading we will reproduce the appropriate row of table 9.3 (viz. row 7 and 9), before discussing the results of the experiment.

Below, in our discussion of the unknown variables (viz. UV1 and UV2),

- we display only the variables that were considered by the J48 decision tree (i.e., the possible correlations between the variables that were not considered by the J48 decision tree, are neither noted, nor discussed),
- we display these variables in the order in which they were considered by the J48 decision tree (for convenient reading -and to avoid confusion with the reference numbers issued to the unknown variables (viz. UV1 and UV2)-, we issued these variables a character (A) to (C)).

UV1: Terrorist organisation

Variable	ZeroR	J48
Terrorist organisation	6.80	67.53

For the variable *Terrorist organisation* the J48 algorithm produces a considerably higher result (67.53%) than the ZeroR baseline classifier (6.80%); the difference being 60.73 percentage points. This result is attained by a decision tree that considers three variables respectively.
(A) *Country*
(B) *Year*
(C) *Type of antagonist(s)*

For an interpretation of the relation between the variables *Terrorist organisation* and *Country*, *Year*, and *Type of antagonist(s)* we refer to our discussion "UV2 *Terrorist organisation*" of the first experiment.

UV2: Ties with third parties

Variable	ZeroR	J48
Ties with third parties	6.81	67.62

The J48 decision tree produces a higher result (67.62%) for the variable *Ties with third parties* than the baseline classifier (6.81%); the difference being 60.81 percentage points. This result is attained by a decision tree that considers three variables respectively.
(A) *Year*
(B) *Country*
(C) *Type of antagonist(s)*
Below we will briefly reflect on the correlation between the variable *Ties with third parties* and these three variables.

For an interpretation of the relation between the variables *Ties with third Parties* and *Year*, *Country*, and *Type of antagonist(s)* we refer to our discussion "UV3 *Ties with third Parties*" of the first experiment.

Additionally, we note that the fact that in both the decision trees of UV1:*Terrorist organisation* and UV2:*Ties with third parties*, the same variables are considered. This confirms the -rather obvious- relation between a terrorist organisation and the third party it is affiliated with. We therefore tentatively conclude that the variable *Terrorist organisation* holds a strong predictive value for the variable *Ties with third party*, and vice versa. For example, based on the data accumulated in the ESP PANDORA, we may expect that the terrorist organisation "Jemaah Islamiya" always correlates with the third party "Moro National Liberation Front Splinter group".

Concluding the second experiment

With the second experiment, we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in in the process of adapting to developing criminal behaviour.

In the setup of the experiment, we assumed that when a law-enforcement agency faces an actual terrorist attack against a person or object, the ten unknown variables provide valuable information in the process of taking appropriate action to deal with adapting to developing criminal behaviour (see definition 2.6: adapting). Moreover, we assumed that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in adapting to developing criminal behaviour.

The accuracy percentages generated by the second data-mining experiment, show that for two of the ten unknown variables (viz. *Terrorist organisation* and *Ties with third parties*), the J48 classifier produced accuracy percentages that are substantially higher than those generated by the ZeroR baseline classifier (see figure 9.6). Therefore, we tentatively conclude that data-mining techniques may give preference in the ordering of the unknown variables to a high degree of accuracy. This ordering may subsequently help criminal investigators, to adequately adapt to developing criminal behaviour.

Therefore, based on the results of the second data-mining experiment, we may conclude that in the case of a threatening situation, data-mining techniques, applied to the ESP PANDORA II, (a) enhance the accuracy of the ESC12 scenario model, and (b) are therefore able to assist law-enforcement agencies in the process of adapting to developing criminal behaviour.

9.4.3 Discussion of the third experiment

With the third experiment we tried to assess to what extent data-mining techniques, applied to the ESP PANDORA II, are able to assist law-enforcement agencies to anticipate future criminal behaviour. This experiment is based on a situation in which law-enforcement agencies can pro-actively engage a possible terrorist attack that might take place in the future. In the process of adaptation, law-enforcement agencies have to be able to make decisions concerning future events in a timely and effective fashion, based on the interpretation of past events (see definition 2.6: anticipating).

In the design of the third experiment we assume that in anticipating future attacks, none of the sixteen variables are known. Moreover, we assume that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in anticipating future criminal behaviour.

Below, we will discuss the five variables of which the J48 classifier delivered an accuracy percentage that is more than 10 percentage points higher than the baseline classifier (see subsections 9.2.3 and 9.3.3). These variables are:
UV1: *Country*
UV2: *Terrorist organisation*
UV3: *Ties with third parties*
UV4: *Type of incident*
UV5: *Weapon sub-category*.

Below, we will discuss these five unknown variables. For convenient reading we will reproduce the appropriate row of table 9.7 (viz. row 2, 7, 9, 12, 14, and 15), before discussing the results of the experiment.

Below, in our discussion of the unknown variables (viz. UV1 to UV5),

- we display only the variables that were considered by the J48 decision tree (i.e., the possible correlations between the variables that were not considered by the J48 decision tree, are not noted, nor discussed),
- we display these variables in the order in which they were considered by the J48 decision tree (for convenient reading -and to avoid confusion with the reference numbers issued to the unknown variables (viz. UV1, to UV5)-, we issued these variables a character (A) to (F)).

UV1: Country

Variable	ZeroR	J48
Country	2.59	46.26

The result shows that (based on incidents that took place before 2007) the J48 classifier was able to predict the *Country* of a terrorist attack (that took place between 2007 and 2010) with an accuracy percentage (46.26%) that is considerably higher than the baseline classifier ZeroR (2.59%); the difference being 43.67 percentage points. To attain this accuracy, the decision tree considers the correlations between *Country*, and the following variables:
(A) *Terrorist organisation*
(B) *Part of multiple-incident*
(C) *Successful incident*
Below we will briefly reflect on these correlations.

A: *Terrorist organisation*
In the discussion of the first two experiments we have indicated that, based on the data accumulated in PANDORA II, we observed that terrorist organisations primarily operated in specific countries (which do not necessarily have to be their "home-countries"). Therefore, the fact that the J48 decision tree considers the variable *Terrorist organisation* to have a predictive value in the anticipation of the variable *Country*, is rather obvious.

B: *Part of multiple-incident*
According to the data in PANDORA II, the separate incidents that comprised a "multiple incident" always occurred in the same country. Therefore, the fact that the J48 decision tree considers *Part of multiple-incident* in the decision tree for the variable *Country* is rather obvious.

C: *Successful incident*
The J48 decision tree considers the successfulness of previous incidents (on the same antagonist) to indicate the value for the variable *Country*. According to the tree, these attempts hold valuable information with respect to the anticipation of the variable country. This may be explained by the fact that, when more than one

attack is executed on one individual antagonist, these attacks generally occur in the same country.

UV2: Terrorist organisation

Variable	ZeroR	J48
Terrorist organisation	2.50	83.92

The result indicate that the J48 classifier was able to predict the *Terrorist organisation* of a prospective attack with an accuracy (of 83.92%) that is considerably higher than the baseline classifier ZeroR (2.5%); the difference being 80.79 percentage points. Remarkably, this result is achieved by a decision tree that only considers one variable.

(A) *Ties with third parties*.

A: *Ties with third parties*

The data accumulated in ESP PANDORA II suggests (i) that specific third parties[75] are strongly correlated with certain terrorist organisations, and (ii) that this correlation that was identified by the J48 classifier based on the training set (the incidents that occurred before 2007), apparently persists after 2007. For example, from the data we conclude that the terrorist organisation "Jemaah Islamiya" strongly correlates with the third party "Moro National Liberation Front Splinter group". Consequently, if an incident arises in which it becomes apparent that a certain third party maintains connections with an unknown *Terrorist organisation*, the latter may successfully be anticipated.

UV3: Ties with third parties

Variable	ZeroR	J48
Ties with third parties	2.50	68.40

[75] A "third party" refers to any terrorist, criminal or clandestine group(s) that the protagonist (or *terrorist organisation*) is not officially related to, yet maintains connections with (see *Protagonist* V24).

In addition to the previous variable, the J48 classifier seems to be quite successful in the prediction of *Ties with third parties* (68.40%). The result shows that the classifier was able to predict the variable *Ties with third parties* with an accuracy that is 65,90 percentage points higher than the accuracy percentage of the baseline classifier ZeroR (2.50%). To attain this result, the J48 decision tree relates *Ties with third parties* only to one other variable.
(A) *Terrorist organisation*

A: *Terrorist organisation*
For an interpretation of the relation between the variables *Ties with third Parties* and *Terrorist organisation,* we refer to our discussion "UV2 *Ties with third Parties*" of the third experiment.

Conclusively we note that the results indicate that, if an incident arises in which the *Terrorist organisation* is known, it may be possible (based on historic cases) to anticipate the third party it is affiliated with (the variable *Ties with third parties*) to a rather high degree of accuracy. Additionally, if in an incident the variable *Ties with third parties* is known, the variable *Terrorist organisation* may be anticipated to a rather high degree of accuracy. We therefore reiterate our conclusion that the variable *Terrorist organisation* holds a strong predictive value for the variable *Ties with third party*, and vice versa.

UV4: Type of Incident

Variable	ZeroR	J48
Type of incident	53.51	77.90

The J48 classifier seems to be quite successful in the prediction of *Type of incident*. The result shows that the classifier was able to predict this variable with an accuracy (of 77.90%) that is higher than the baseline classifier (53.51%); the difference being 24,39 percentage points. The J48 decision tree for the variable *Type of incident* considers six variables.
(A) *Weapon sub-category*
(B) *Antagonist(s) die(s) from attack*
(C) *Total fatalities*
(D) *Terrorist organisation*

(E) *Type of antagonist(s)*

(F) *Successful incident*

Below we will briefly reflect on the correlation between *Type of incident* and these six variables.

A: *Weapon sub-category*

The decision tree indicates a correlation between the *Type of incident* and the *Weapon sub-category*. This seems obvious as, to a certain extent, the *Type of incident* dictates the *Weapon sub-category*. For example, if the type of incident is a Bombing (*Means* V1 cat 3), the *Weapon sub-category* will be "Explosives / Bombs / Dynamite" (*Means* V4 cat 6).

B: *Antagonist(s) die(s) from attack*

Additionally, the J48 decision tree indicates a correlation between the *Type of incident* and whether or not the *Antagonist(s) die(s) from attack*. While the decision tree does not provide us with an adequate explanation for the role of this variable, we have noted negative correlations between *Type of incident* and *Antagonist(s) die(s) from attack*. For example, in PANDORA II no "Computer network attack / Electronic warfare" (*Means* V1 cat 7) incidents are recorded in which the *Antagonist* (which usually comprises of a set of computers) died from the attack. Moreover, in the successful incidents recorded in the dataset in which the *Antagonist* is a building or object, the *Antagonist* obviously does never die from the attack. This negative correlation may explain why the J48 decision tree considers the variable *Antagonist(s) die(s) from attack* when trying to anticipate the variable *Type of incident*.

C: *Total fatalities*

The correlation between the variables *Type of Incident* and *Total fatalities*, seems a logical one. For instance, if the *Type of incident* is a "Bombing" (*Means* V1 cat 3), there are usually more fatalities than when the incident is an "Assassination / Liquidation" (*Means* V1 cat 1). It is therefore quite understandable that the J48 decision tree considers the variable *Total fatalities* when trying to anticipate *Type of incident*.

D: *Terrorist organisation*,

The data accumulated in the ESP PANDORA II shows several examples of the correlation between the variables *Terrorist organisation* and *Type of incident*. For example, the *Terrorist organisation* Al Qaeda that correlates with the *Type of incident* "Hostage taking / kidnapping" (*Means* V1 cat 7), or the *Terrorist organisation* Hizballah that strongly correlates with the *Type of incident* "Bombings" (*Means* V1 cat 3). These correlations may indicate why the J48 decision tree considers the variable *Terrorist organisation* when trying to anticipate *Type of incident*.

E: *Type of antagonist(s)*

The correlation between *Type of incident* and *Type of antagonist(s)* was discussed in "UV5: *Type of incident*" in the second experiment, where we referred to the terrorist planning cycle (TPC). Terrorists generally aim to minimize the risk of their operation while aiming to achieve the highest probability of success (see subsection 3.6.2). The *Type of antagonist(s)* to a certain extent dictates the *Type of incident* with the highest probability of success. For instance, when terrorists plan an attack on the telecommunication infrastructure (*Antagonist* v5 cat 16), the *Type of incident* might well be a "Computer network attack / Electronic warfare" (*Means* V1 cat 7), while "Assassination / Liquidation" (*Means* V1 cat 1) seems less plausible. In contrast, when the *Type of antagonist(s)* is a religious figure (*Antagonist* v5 cat 15), the *Type of incident* "Computer network attack / Electronic warfare", does not seem probable. These correlations may indicate why the J48 decision tree considers the variable *Type of antagonist(s)* when trying to anticipate *Type of incident*.

F: *Successful incident*

We observed that the J48 decision tree of *Type of incident* considers the variable *Successful incident*. However, we are not able to explain this decision, nor any correlation between these variables.

UV5: Weapon sub-category

Variable	ZeroR	J48
Weapon sub-category	15.23	45.20

The result depicted above shows that the J48 classifier was able to predict the *Weapon sub-category* of a prospective attack with an accuracy (45.20%) that is considerably higher than the ZeroR baseline classifier (15.23%); the difference being 29.97 percentage points. The result is achieved by a J48 decision tree that considers ten variables.

(A) *Type of incident*
(B) *Antagonist(s) die(s) from attack*
(C) *Year*
(D) *Country*
(E) *Terrorist organisation*
(F) *Suicide mission*
(G) *Type of antagonist(s)*
(H) *Part of multiple-incident*
(I) *Total injuries*
(J) *Successful incident*

Below we will briefly reflect on the correlation between *Type of incident* and these ten variables.

A: *Type of incident*

For a discussion of the correlation between the variables *Weapon sub-category* and *Type of incident*, we refer to the discussion of the results of "UV5:*Type of incident*" of the third experiment.

B: *Antagonist(s) die(s) from attack*

For a discussion of the correlation between the variables *Weapon sub-category* and *Antagonist(s) die(s) from attack*, we refer to the discussion of the results of "UV6: *Weapon sub-category*" of the second experiment.

C: *Year*

For a discussion of the correlation between the variables *Weapon sub-category* and *Year*, we refer to the discussion of the results of "UV6: *Weapon sub-category*" of the second experiment.

D: *Country*

For a discussion of the correlation between the variables *Weapon sub-category* and *Country*, we refer to the discussion of the results of "UV6: *Weapon sub-category*" of the second experiment.

E: *Terrorist organisation*

For a discussion of the correlation between the variables *Weapon sub-category* and *Terrorist organisation*, we refer to the discussion of the results of "UV6: *Weapon sub-category*" of the second experiment.

F: *Suicide mission*

Based on the J48 decision tree, we observe that there is a correlation between the variables *Weapon sub-category* and *Suicide mission*. This correlation seems plausible since the majority of suicide missions involve explosives. Consequently, in the anticipation of the *Weapon sub-category* the J48 decision tree considers the variable *Suicide mission*.

G: *Type of antagonist(s)*

For a discussion of the correlation between the variables *Weapon sub-category* and *Type of antagonist(s)*, we refer to the discussion of the results of "UV6: *Weapon sub-category*" of the second experiment.

H: *Part of multiple-incident*

In the anticipation of the *Weapon sub-category* the J48 decision tree considers the variable *Part of multiple-incident*. This correlation seems plausible as a study of the data in the ESP PANDORA II indicates that Weapon sub-categories such as "Explosives / Bombs / Dynamite" (*Means* V4 cat 6), are frequently used in attacks that comprise multiple-incidents.

I: *Total injuries*

The relation between the variables *Weapon sub-category* and *Total injuries* seems a logical one. For instance, if the number of people injured is large, a *Weapon sub-category* such as "Explosives / Bombs / Dynamite" (*Means* V4 cat 6) or "Nuclear" (*Means* V4 cat 4) seems more plausible that a *Weapon sub-category* such as "Hands, feet, fists" (*Means* V4 cat 9, Subcat v).

J: *Successful incident*

We observed that the J48 decision tree of the variable *Weapon sub-category* considers the variable *Successful incident*. However, we are not able to explain this decision, nor the correlation between these variables.

Concluding the third experiment

With the third experiment, we tested to what extent data-mining techniques applied to the ESP PANDORA II, are able to assist law-enforcement agencies in the process of anticipating criminal behaviour.

In the setup of the experiment, we assumed that when a law-enforcement agency needs to engage pro-actively a possible terrorist attack that might take place in the future (see definition 2.7: anticipating), all the sixteen unknown variables may provide valuable information in the process of anticipating to developing criminal behaviour. Moreover, we assumed that enhancing the accuracy values for the unknown variables would assist law-enforcement agencies in anticipating future criminal behaviour.

The results generated by the third data-mining experiment, show that the J48 classifier produced accurate percentages that are more than 10 percentage points higher than the ZeroR classifier for the five variables *Country*, *Terrorist organization*, *Ties with third parties,* Type *of* incident, Weapon *sub-category* (see figure 9.7).

Therefore, based on the aforementioned results, we may conclude that data-mining techniques applied to the ESP PANDORA (a) enhance the accuracy of the ESC12 scenario model, and (b), support law-enforcement agencies in anticipating future criminal behaviour.

9.5 Answer to research question 4

In this chapter we addressed RQ4 [*To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law-enforcements agencies to anticipate criminal behaviour?*].

To approach this research question, we conducted three separate tests in which we applied the J48 data-mining algorithm to sixteen variables of the ESP PANDORA II. The experiments were designed to represent situations in which law-enforcement agencies are required to (1) learn from, (2) adapt to, and (3) anticipate criminal behaviour.

The accuracy percentages of the J48 decision tree that were generated by the three experiments, indicate that applying the J48 classifier to the ESP PANDORA II enhances the ability of the ESC12 scenario model considerably. Moreover, the results of the experiments indicate (i) that the variables of the ESP PANDORA II do correlate with each other, and (ii) the classifier J48 decision tree is able to predict the value of variables on the basis of other variables.

With respect to the fourth research question of this thesis, we may conclude the following.

1. Data-mining techniques are valuable in the anticipation of criminal behaviour. This finding coincides with previous research in this field (cf., Brown, 1998; Chen et al., 2004; Corcoran et al., 2003; McCue, 2005).
2. Data-mining techniques, applied to the ESP PANDORA II, can adequately assist law-enforcement agencies in anticipating criminal behaviour.

Based on these conclusions, we answer the fourth research by concluding that data-mining techniques applied to a scenario model actually enhance the ability of law-enforcement agencies to anticipate criminal behaviour.

Additionally, we remark that we would encourage the experiments conducted in this chapter to be repeated with other, more elaborate, data-mining algorithms to see if the anticipative value of the ESP PANDORA can be enhanced even further.

10

TEN | Conclusions

Problems cannot be solved by the same level of thinking that created them.

Albert Einstein[76]

This chapter provides a summary of answers to the four research questions. Subsequently, it presents an answer to the problem statement, followed by a conclusion. Finally, five directions for future research are proposed.

[76] Albert Einstein (1879 – 1955), German-born physicist who developed the special and general theories of relativity. Einstein is generally considered the most influential physicist of the twentieth century.

In this chapter we will summarise the answers to the four research questions, the problem statement, and formulate the conclusion of our research. Referring to the words by Einstein quoted at the beginning of this chapter, we aim to solve our "problem" by bringing together three "levels of thinking": Law enforcement, Science, and Art. The extent to which the problem is solved by amalgamating these levels of thinking, is the subject of this chapter.

In section 10.1 we provide the announced summary of the answers to the four research questions. In section 10.2, we answer the problem statement and formulate a research conclusion. Finally, in section 10.3 we recommend five directions for future research.

10.1 Answers to the research questions

In this section we reiterate and summarise the answers to the four research questions that were formulated in chapter one. As the flow of the argument in this thesis is not completely linear, we have included paragraphs in the discussion that indicate on which chapters the answer to the research question is built.

Research question 1

What does literature on scenario-based anticipation methods offer that is relevant for the development of a scenario model by which criminal behaviour can be anticipated?

The answer to the first research question is derived from the chapters two and three. In fact we synthesised information from two sources:

1. the theoretical basis for our thesis, as formulated in chapter two;
2. a literature review conducted in chapter three.

This approach results in a general and a specific conclusion that are relevant with respect to research question 1.

General Conclusion

Based on the literature studied, we conclude that an effective scenario model is able to accumulate different historic criminal incidents in a systemised way.

Specific conclusion

Based on the literature studied, we further conclude that an effective scenario model will (i) store knowledge and experience gained from previous situations, that in turn can be used for (ii) detecting and analysing trends and unexpected relations. Subsequently, these trends and relations can be extrapolated towards the future to (iii) assist in anticipating future incidents.

Research question 2

To what extent can a scenario model be designed by which criminal behaviour can be anticipated?

The answer to the second research question is derived from chapter three, four, and five. Here we synthesised information from three sources:

1. the answer to RQ1 described in chapter three (see also above);
2. the study of the ESC12 in chapter four;
3. the design of an ESC12 scenario model proposed in chapter five.

In chapter four we explored the role of the ESC12 and arrived at the general conclusion that the ESC12 offer a durable set of components to contribute to (a) learning from, (b) adapting to, and (c) the anticipation of criminal behaviour.

In chapter five we advanced on this conclusion and documented the design of a novel scenario model that allows human operators to anticipate future criminal behaviour. To the best of our knowledge we are the first in attempting to design a anticipative scenario model for use in law enforcement.

We continued our research by separating (1) the conceptual design of the scenario model from (2) the architectural design. We characterise both parts below.

1. In the conceptual design of the scenario model we explore the role of the ESC12 in a scenario model.
2. In the architectural design of the scenario model we propose the integration of four modules (viz. *Data cruncher*, *Scenario matrix*, *Controller*, and *Scenario generator*) that facilitate six processes (viz. *Data pre-processing*, *Data warehousing*, *Facilitating differentiated output*, *Generating differentiated output*, *Feedback* and *Applying knowledge*).

Combining the conceptual design with the architectural design, we created a blueprint for the activities to be generated by an ESC12 scenario model that allow human operators to anticipate future criminal behaviour.

So, we answer RQ2 by specifically concluding that our experimental approach indicates that (a) to design an ESC12 scenario model able to anticipate criminal behaviour is attainable, and (b) an ESC12 scenario model may be created according to an outlined design or blueprint.

Research Question 3

To what extent can a scenario model be used to analyse historic criminal behaviour?

The answer to the third research question is derived from chapter five, six, seven, and eight. Here we synthesised information from four sources:

1. the answer to RQ2 described in chapter five (see also above);
2. the creation of an Experimental Scenario Platform (ESP) in chapter six;
3. a study of the internal structure of the ESC12 in chapter seven;
4. an analysis of historic criminal behaviour from the ESP PANDORA I in chapter eight.

To approach the third research question we created an Experimental Scenario Platform (ESP) named ESP PANDORA I. PANDORA I combines the scenario model proposed in our answer to RQ3, with a dataset of terrorist incidents. We included in the ESP PANDORA I an informative and detailed list of information items about incidents of lone-operator terrorism.

For our analysis of historic criminal behaviour, we selected 40 cases of lone-operator incidents from the PANDORA I dataset that were distributed according to *the four waves of modern terrorism* (cf. Rapoport, 2004). Every wave of modern terrorism in our analysis comprised 10 incidents of lone-operator terrorism.

Next, we compared and contrasted the 10 incidents *per wave*, by analysing the communalities and differences between them. In a *cross-wave analysis* we accumulated the results per wave, and effectively brought together the 40 incidents of lone-operator terrorism in a search for characteristics that specified the trend of lone-operator behaviour over the years. In particular, we were interested in the predictive power of the trend analysis.

From the results obtained, we may conclude that a scenario model based on the ESC12, that accumulates different historic criminal incidents in a systemised way, allows (a) contrasting and comparison of idiosyncratic and seemingly unrelated incidents, and (2) provides an opportunity to analyse historic criminal behaviour in general by transcending the level of individual incidents.

Research Question 4

To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law enforcements agencies to anticipate criminal behaviour?

The answer to the fourth research question is derived from chapter five, six, seven, and nine. Here we synthesised information from four sources:

1. the answer to RQ2 described in chapter five (see also above);
2. the creation of an Experimental Scenario Platform (ESP) in chapter six;
3. a study of the internal structure of the ESC12 in chapter seven;
4. an study of the application of data-mining tools to the ESP PANDORA II in chapter nine.

To address the fourth research question we created a new ESP, named PANDORA II. PANDORA II combines the scenario model proposed in our answer to RQ3, with a dataset that includes general data of 53,289 terrorist incidents.

To approach the fourth research question we conducted three experiments in which we applied data-mining techniques to the ESP PANDORA II. The experiments were designed to represent three different situations in which law-enforcement agencies are required to act.
The results of our experiments indicate that data-mining techniques enhance the ability of the ESC12 scenario model to anticipate criminal behaviour considerably.

From the results, we may conclude that (a) data-mining techniques are valuable in the anticipation of criminal behaviour, and (b) data-mining techniques applied to the ESP PANDORA II adequately assist law-enforcement agencies in anticipating criminal behaviour.

We note that our research is restricted to the application of rather straightforward data-mining algorithms. We assume that the use of more sophisticated data-mining techniques may further improve the results. In section 10.3 we provide recommendations for further research in this direction.

10.2 Answer to the problem statement

In this section we provide an answer to the problem statement. Our answer is based on the flow of the arguments throughout the thesis, and on the responses to the four research questions as presented in the previous section.

Problem Statement

To what extent can a scenario model support law-enforcement agencies in the anticipation of criminal behaviour?

In section 3.3 we have stated that an effective scenario model should satisfy three conditions:

1. Offer the possibility to learn from historic criminal behaviour.
2. Offer the possibility to adapt the chosen strategy on the basis of indicators that are found.
3. Offer the possibility to anticipate (unexpected) future real-world behaviour.

In this thesis we proposed the design for a new and state-of-the-art scenario model, built on the ESC12. Subsequently, we related this ESC12 scenario model to a law-enforcement context by adding data from historic criminal behaviour and measured its effectiveness by assessing the three conditions mentioned above. It resulted in a tri-partite answer to the problem statement.

First, we described and showed that the ESC12 scenario model can successfully, i.e., to a large extent, be used to analyse and learn from historic criminal behaviour, by detecting general characteristics in the behaviour of lone operators.

Second, we described and showed that the ESC12 scenario model can be used rather successfully to adapt to developing criminal behaviour, and change the strategy on the basis of the indicators that are found, by testing its ability to suggest unknown ESC12 variables on the basis of known ESC12 variables.

Third, we described and showed that the ESC12 scenario model can successfully, i.e., to a large extent, be used to anticipate future criminal behaviour, by testing its anticipative potential.

From the results described above, we may conclude that the ESC12 scenario model successfully can support law-enforcement agencies in the anticipation of criminal behaviour.

10.3 Future research

The research presented in this thesis is complex, and simultaneously promising. By attempting to design a scenario model able to anticipate criminal behaviour, we entered "uncharted territory". The exploration of this territory presented us with many challenging views and appealing new avenues of investigation. Notwithstanding the fact that our exploration was fascinating, it required us to stay close to the scope of our research, and to navigate carefully. In this process we inevitably had to discard tempting avenues and promising areas of investigation Apparently, we left them for future research. Below we propose five recommendations for future research.

1: Enhance the infrastructure

In our research we determined that the ESC12 offer an effective and durable set of components to describe, characterise and model criminal behaviour. However, we also argued that the ESC12 represent categories that are too broad to capture all relevant details of criminal behaviour. So, we studied the internal structure of the ESC12 and proposed to subdivide the scenario components in 98 variables. While we did not find information related to criminal behaviour that could not be attached to one of the 98 variables, we expect that the internal structure of the ESC12 as proposed, might require modification when more data is attached to the ESC12 scenario model. So, possible future research in this direction is to investigate whether the internal structure of the ESC12 can be enhanced in such a way that it can accommodate all the relevant data related to criminal behaviour.

2: Investigate more elaborate data-mining techniques

Our research demonstrated that the application of data-mining algorithms to the ESC12 scenario model enhances the anticipative quality of the model. In our experiments we used the J48 decision tree, which is a fairly straightforward algorithm. We expect that the application of more elaborate data-mining algorithms such as Support Vector Machines (SVM's) might render surpassing results. So an obvious suggestion for further research is to investigate to what extend other data-mining tools would enhance the anticipative value of the scenario model.

3: Apply Case-based Reasoning on the ESC12 scenario model

Advancing on the second suggestion for further research is the application of Case-based Reasoning (CBR). In chapter one we referred to research that indicated that CBR might be able to enhance the anticipative powers of the ESC12 scenario model (see Spronck, 2010). In CBR information from historical situations is stored as "cases" in a database. When a new situation arises, CBR can search for historical cases with similar characteristics and suggest the best possible approach associated with a particular set of conditions. While there might be an obvious relation between the design of the ESC12 scenario model and the process of CBR, we did not include CBR in our research. Therefore, an interesting direction for future research would be to apply CBR on the ESC12 scenario model and to assess the effect on he anticipative capabilities of the model.

4: Investigate relation between actual incidents and works of fiction

In the previous chapters we argued that there is a strong analogy between a theatrical performance and a terrorist act. Moreover, we argued that the ESC12 effectively represent the elements that make up works of fiction, as well as the elements that make up a terrorist act. However, in testing the ESC12 scenario model, we exclusively directed our attention at terrorist incidents that actually did take place. Because the ESC12 scenario model provides the opportunity to add creative narratives to the scenario model, it would be interesting to investigate the relation between works of fiction and actual terrorist incidents. To elaborate on this direction for research, and to suggest a foundation for future studies, we added an extra chapter to this thesis entitled "Deleted scenes".

5: Investigate the use of the ESC12 scenario model in other contexts

As a final recommendation for further research, we would like to encourage the investigation of the use of an ESC12 scenario model in other than law enforcement contexts. Obviously, as the title of this thesis indicates, we focused our attention on a scenario model by which criminal behaviour may be anticipated. Yet, based on the experience gained during our research, we expect that an ESC12 scenario model might be applicable in other fields such as fraud detection.

11

ELEVEN | Deleted scenes

I knew a girl at school called Pandora…
…never got to see her box, though.

Notting Hill, (1999)[77]

In "Deleted scenes" we take a sneak preview of the future of the ESC12 scenario model by investigating to what extent text-mining techniques are able to extract automatically values for the ESC12 variables from creative narratives.

[77] Notting Hill (1999) is a romantic comedy directed by Roger Michell. *Notting Hill; The ultimate edition* was released in 2001 and included six deleted scenes that were omitted from the feature film.

It is a common tradition in film production to eliminate scenes that are perceived to have an adverse effect on the flow of the narrative. "Deleted scenes" refers to the footage that was recorded during a film production, but was omitted from the final version of the film in the process of editing. Occasionally, deleted scenes are made available as a bonus feature during the commercial release of a motion picture. While these scenes did not fit the flow of the narrative, they are believed to offer a valuable addition to the subject of the film.

In accordance with the tradition of appending deleted scenes to a film release, we have added an extra chapter to this book. In *Deleted scenes* we conduct a preliminary investigation into two claims that did not seem to fit the flow of the narrative, yet are believed to offer a valuable addition to the subject of our research.

As we argued in the previous chapters, there seems to be a strong analogy between a theatrical performance and a terrorist act (see section 4.1). The fact that (a) the ESC12 scenario model is rooted in the creative industry, and (b) there is an apparent relation between terroristic and creative narratives, provides us with the opportunity to add creative narratives to the ESC12 scenario model. During our research, this notion led to the following two claims.

Claim 1: Combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model.

Claim 2: Text-mining techniques would enable the automatic extraction of potential values for the ESC12 variables from works of fiction[78].

While the abovementioned claims appeared thought provoking and appealing, we decided to exclude them from the Ph.D. research. As we assumed, they would open avenues of investigation that would exceed the scientific objective of our study (see section 1.2). However, as a suggestion for future research and a foundation for further study, we decided to add a chapter to the thesis. "Deleted scenes" in our opinion, presents a valuable perspective on the future of the ESC12 scenario model.

[78] We regard as work of fiction any work that deals, in part or in fulll, with information or events that are not real but rather imaginary and theoretical; that is, invented by an author.

To investigate to what extent combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model, we will elaborate on the nexus between terroristic and creative narratives that we discovered during our research in section 11.1. In section 11.2 we will investigate to what extent text-mining techniques enable the automatic extraction of values for the ESC12 variables from works of fiction. Section 11.3 summarises the results of our text-mining experiment, and section 11.4 concludes this chapter with a chapter summary.

11.1 The nexus between terrorist and creative narratives

To stimulate further investigation of claim 1 [*Combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model*], we will elaborate on the nexus between terroristic and creative narratives, that was discovered during our research.

In our study of the potential of an anticipative scenario model, we found several examples of terrorist incidents that carried a strong resemblance with works of fiction. To emphasise the nexus between terroristic and creative narratives, and to illustrate the potential of augmenting the ESC12 scenario model with data from creative narratives we will (a) draw on other relevant scientific studies, and (b) demonstrate the nexus by three examples below.

In *Something in the air; terrorism as art*, De Graaff (2007) states that both terrorists and artists use a narrative; a central storyline that defines the behaviour of the individuals involved. Moreover, De Graaff presents a number of examples in which terrorists followed the creative narrative quite literally. We will briefly summarise three of these examples below.

1: *The Secret Agent*

Theodore Kaczynski also known as the Unabomber, strongly identified himself with "the professor" a fictional character from the novel *The Secret Agent*, written by Joseph Conrad (Jackson, 1996). The professor rejects the academic world and decides to live in reclusion. From his hideout he aims to target the scientific progress of the world by creating home made explosives.

Kaczynski read *The Secret Agent* in his hideout in Montana, and copied the mindset and lifestyle of the professor. He created home-made explosives and directed his bombing campaign against people involved with scientific progress. Additionally, Kaczynski used the name "Conrad" as an alias on various occasions (cf. Houen, 2002; De Graaff, 2007).

2: *Black Abductor*

In 1972 the novel *Black Abductor* was published, in which a left wing revolutionary group kidnaps a student named Patricia Prescott, daughter of an influential politician (Ellenberg, 1974). The group decides to "brainwash" Patricia until she becomes one of their own.

Two years after publication of the novel, the Symbionese Liberation Army (SLA), a left wing revolutionary group, kidnaps a student named Patricia Hearst, daughter of an influential media magnate. Hearst was held captive for eighteen months and later claimed to have been "brainwashed" up until the point that she adopted the views of her captors. Hearst even collaborated with the SLA in a bank robbery. While the FBI mentioned the numerous similarities between the book and the kidnapping, they did not deliver definitive evidence for a link between the novel and the modus operandi of the SLA (cf. De Graaff, 2007).

3: *The Turner Diaries*

When Timothy McVeigh (also known as "the Oklahoma city bomber") was arrested, police found a page of *The Turner Diaries* in the trunk of his car, a novel written by William Pierce; leader of the neo-nazist National Alliance. McVeigh read the book numerous times and sold it at gun shows throughout the US (Reilly 1998). McVeigh copied the concept of "leaderless resistance" from the writings of Pierce, and embraced the ambition to create a revolt against "the tyrannical federal government" that was described in the novel. In concurrence with the Turner Diaries, McVeigh directed his attack at a federal building. Moreover, copying the modus operandi described by Pierce, he used an explosive mix of 5,000 pounds of ammonium nitrate fertilizer, mounted in the back of a truck (Herbeck & MIchel 2001).

Based on the aforementioned examples, De Graaff (2007) contemplates that, "fortunately or unfortunately, art has often led the way to reality"[79]. Moreover, he states that every terrorist organisation creates its own narrative: "One of the greatest achievements of Al Qaeda is the creation of the narrative of oppression of the Islamic community, which will eventually lead to a resurrection of the Khalifat" Moreover, De Graaff concludes that the "the narrative of art" may be well used to anticipate "the narrative of terrorism".

In a TED[80] talk, McCue (2012) advances on the notion of "terrorism narrative" in which he compares Al Qaeda to a commercial brand: "Al Qaeda was essentially a product on a shelf in a souk somewhere, which not many people had heard of. Nine-eleven launched it -that was its' big marketing day- and it was packaged for the 21st century. […] They [Al Qaeda] were effectively creating a brand which can be franchised around the world." McCue advances to suggest a counter terrorism strategy based on weakening the credibility of the brand, and eradicating the narrative of terrorism with a counter narrative[81].

In *Naratives and home-grown Jihadist terrorism*, Overheul (2014) investigated (a) the value of narratives in countering home-grown Jihadist terrorism, and (b) the potential of the ESC12 scenario model in anticipating the narrative of potential terrorists. Overheul completes his study by stating that (a) terrorism can be countered more effectively and efficiently by focussing on the narrative of terrorists, and (b) utilising the narratives (from sources such as works of fiction) that are used by terrorists, would enhance the potential of the ESC12 scenario model (Overheul, 2014).

In *Integrating fictional art into Pandora II*, Von Bannisseht (2014) investigated to what extent the ESP PANDORA II may be expanded with fictional art. To this avail she conducted an experiment in which 10 disparate works of fiction[82] were analysed

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[79] De Graaff (2007) refers to Wagge, *Audience* and Smelik *Themapark* for reference to this quote.

[80] TED (Technology, Entertainment, Design) is a global set of conferences, owned by the private non-profit Sapling Foundation, under the slogan "Ideas worth spreading".

[81] McCue does not use the word "narrative" in his talk, but suggests to use the "stories" of the victims of a terrorist act to counter the terrorist narrative.

[82]The books that were included in the experiments are: (1) The Janson directive, (2) Gone tomorrow, (3) Teeth of the tiger, (4) Transfer of power, (5) Executive power, (6) Sum of all fears, (7) The afghan, (8) 3rd degree, (9) Day of the Jackal, (10) Reamde.

and compared with actual terrorist incidents present in the PANDORA II database. This comparison yielded evidence that writers have been inspired by terrorist attacks, but also that a terrorist was inspired by one of the novels in the test set. Von Bannisseht noted that for the novel *3rd degree* the program retrieved three results: (1) the Hariri case (2005), (2) the Hamadeh case (2004), and (3) the US embassy case (1983). Because of the strong correlation between the ESC12 (and its variables) in the novel, and the Hamadeh case, Von Bannisseht concludes that it is definitely possible that the protagonist of the Hamadeh case was inspired by the book *3rd degree* (The novel was published in March 2004; Hamadeh was assassinated in October of that same year.)[83]. Von Bannisseht completes her thesis by noting that the ESP PANDORA II will be enhanced by implementing fictional literature to the dataset, especially when the structure of fictional art is analysed and when this knowledge is used by a text-mining professional (Von Bannisseht, 2014).

As the abovementioned studies and examples suggest, the comparison of creative narratives with terroristic narratives provide for a better and more efficient understanding of criminal behaviour. Therefore, we postulate that combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model.

11.2 Experimental setup

The notion that data from works of fiction would enhance the potential of the ESC12 scenario model, led us to investigate claim 2 of this chapter [*Text-mining techniques would enable the automatic extraction of the ESC12 variables from works of fiction*] by conducting a text-mining experiment. First, we will provide a brief introduction into *text mining*. Second, we will elaborate on the *dataset* that was used for the experiment. Third, we will focus on the *rules* that were created to extract the ESC12 from the dataset by means of text mining.

Text mining

Text mining refers to the process of extracting meaning from texts and transforming the content of unstructured text into structured data that can be standardised, matched upon, and integrated into a database (Scholtes, 2012).

[83] For more detailed information about the experiment and the obtained results, we refer to the thesis *Integrating fictional art into Pandora II* (Von Bannisseht, 2014).

Instead of recognising individual words, text mining deals with detecting linguistic or statistical word patterns. Information can be retrieved from text files such as books, e-mails, or writings, but also by using additional tools that assign text to multimedia formats such as audio, video files, and photos. One of the approaches to retrieve information from texts is rule-based extraction. A rule instructs a text-mining program what results to deliver. For our experiment we used the text-mining tool *ZyLAB Professional Text Mining*[84] that allowed us to create rules, and to test those rules on text files.

In text mining, *recall* and *precision* are two important measures by which search strategies may be evaluated (Scholtes, 2014).

- Recall refers to the ratio of the number of relevant records retrieved, to the total number of relevant records in the database.
- Precision refers to the ratio of the number of relevant records retrieved, to the total number of irrelevant and relevant records retrieved.

Both recall and precision are usually expressed as a percentage[85].

With our experimental setup we conducted a preliminary test of claim 1 that text-mining techniques may enable the automatic extraction of the ESC12 variables from works of fiction. In our investigation we expect that, while the computer may automatically retrieve the value of a number of candidate values for ESC12 variables (recall), the end user may need to assess the values of the presented variables (and, in doing so, enhance the precision).

Dataset

In the setup of our experiment we took into consideration that, because of their unstructured nature, fictional texts are much harder to mine than (less-unstructured) police reports (Scholtes, 2014). Moreover, we accepted the fact that the ESC12 include components such as *Context* and *Motivation* that may be hard to detect because of the nature of fictional texts.

[84] *ZyLAB Professional Text Mining* (*PTM*) automatically identifies, tags and indexes named entities in a document, such as persons, organisations, places, addresses and dates. We were allowed to use *ZyLAB PTM* through the courtesy of *ZyLAB*.

[85] Assume a program for recognising protagonists in a piece of text, identifies eight protagonists in a text that contains ten protagonists and some antagonists. If six of the identifications are correct, but two are actually antagonists, the program's recall is 60% (6/10), while its precision is 75% (6/8).

For the text-mining experiment, we created a dataset in which we used thirteen works of fiction that were written by Frederick Forsyth. The novels included in the experiment are shown in alphabetical order in Table 11.1.

	Title	Year of Publishing
1	Avenger	2003
2	Day of the Jackal	1971
3	Icon	1996
4	The Afghan	2006
5	The Cobra	2010
6	The Deceiver	1991
7	The Devil's Alternative	1979
8	The Dogs of War	1974
9	The Fist of God	1994
10	The Fourth Protocol	1984
11	The Negotiator	1989
12	The Odessa File	1972
13	The Shepherd	1975

Table 11.1 Thirteen novels that were used for the text-mining experiment.

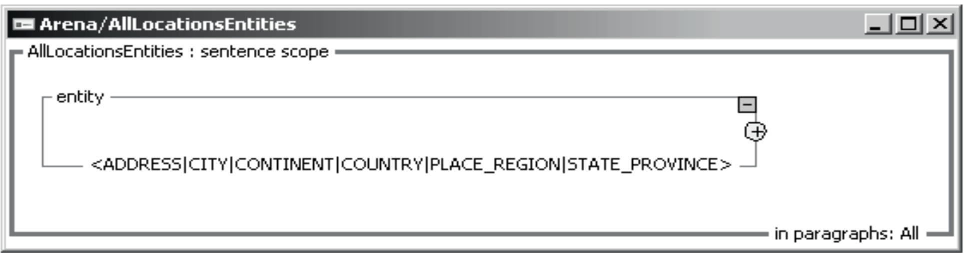
Rules

In order to extract the values of the ESC12 variables from the novels by means of text mining, we applied text-mining rules to the thirteen novels listed in table 11.1. First, we retrieved the values of the ESC12 variables from the novels using rule-based extraction. Next, we saved the results to a CSV-file (comma separated value), which was exported into Microsoft Excel. Finally, fairly straightforward statistical analysis tools were used to classify and rank the results.

For reasons of brevity we will limit our discussion to the rules that were created for the Elementary Scenario Components *Arena*, *Timeframe*, *Context*, *Antagonist*, *Means*, and *Resistance*. Moreover, because the mere emphasis of this chapter lies on assessing the potential of text mining, we will only briefly discuss the rules we created. For a more elaborate discussion of these rules, we refer to *Integrating fictional art into Pandora II* (Von Bannisseht, 2014).

Arena

For the Elementary Scenario Component *Arena*, we created two separate rules. The first rule was created for a basic extraction of all locations from a text. The second rule aims to extract only locations when they are linguistically positioned in the vicinity of words indicating an incident. This rule extracts the entire sentence in which such occurrences take place. Figure 11.2 is a visualisation of the rules that were created for the Elementary Scenario Component *Arena*.



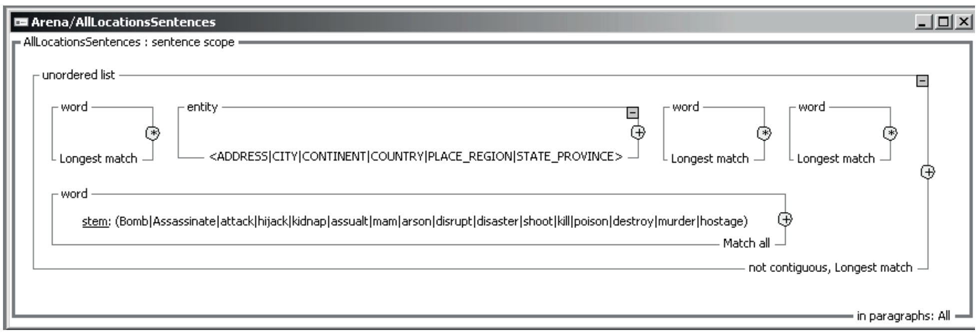


Figure 11.2 Text-mining rules created for the ESC *Arena*.

Timeframe

To retrieve variables related to the Elementary Scenario Component *Timeframe*, we created rules related that aim to extract: (1) Date, (2) Day of the week, (3) Month, (4) Holiday, (5) Year, (6) Time period, and (7) Time. Figure 11.3 is a visualisation of the rule that was created for the Elementary Scenario Component *Timeframe*. The rule aims at a basic entity extraction of all temporal and time indications from a text.

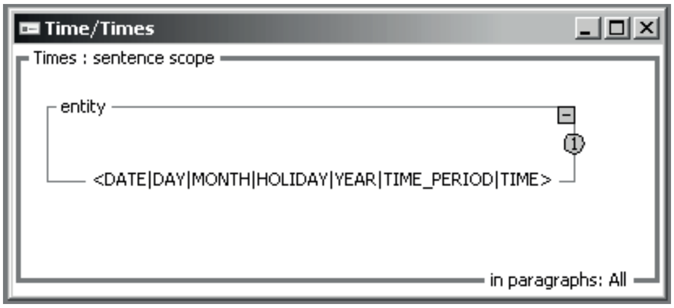
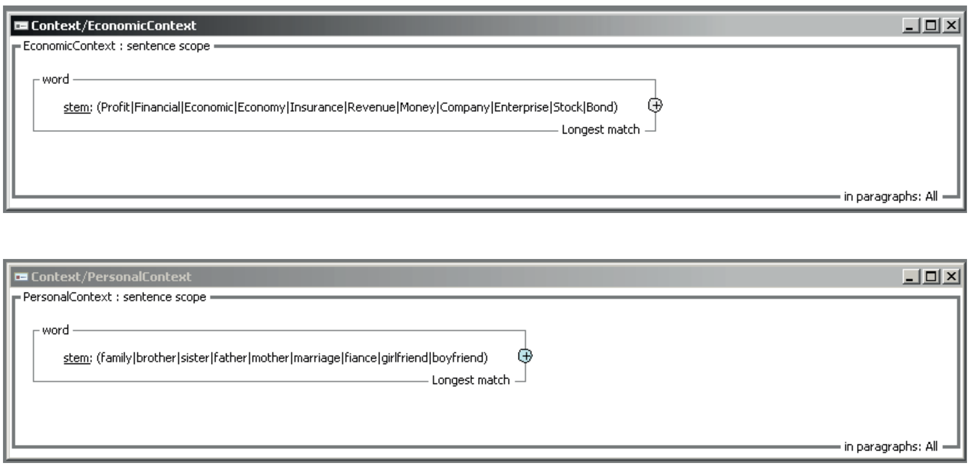


Figure 11.3 Text-mining rules created for the ESC *Timeframe*.

Context

For the Elementary Scenario Component *Context*, we created rules based on four repositories of words (viz. Economic, Personal, Political, and Religious). By creating word repositories, we intended to detect information about the context of a story. For example, words that are assigned to the repository "Political" are *parliament*, *party*, *freedom, politics etc*. In contrast, words assigned to the repository "Personal", are family, brother, fiancé etc. The rules we designed, establish that the repository that is most dominant in the novel, determines the context of a terrorist incident. Figure 11.4 is a visualisation of the rules that were created for the Elementary Scenario Component *Context*.



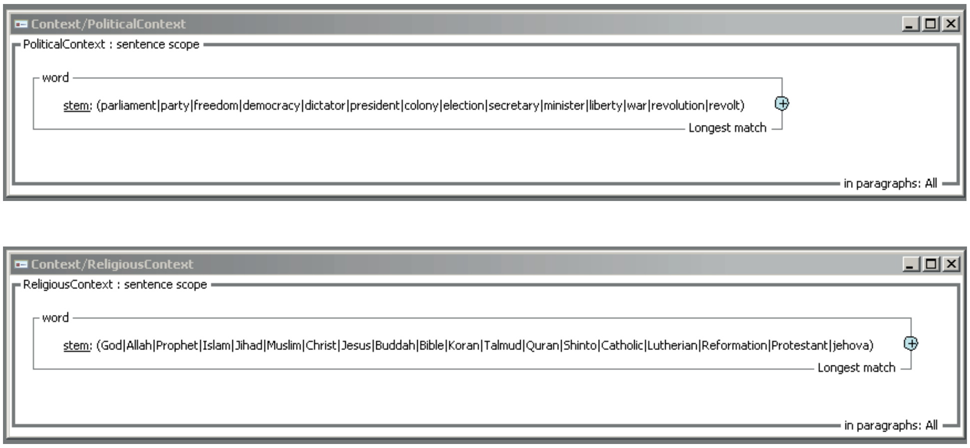


Figure 11.4 Text-mining rules created for the ESC *Context*.

Antagonist

To extract information of the Elementary Scenario Component *Antagonist*, we created rather complex text-mining rules. The rules aim to detect a linguistic combination of active verb forms of incident related words, with a person or organisation within the same sentence. Figure 11.5 is a visualisation of the rules that were created for the Elementary Scenario Component *Antagonist*.

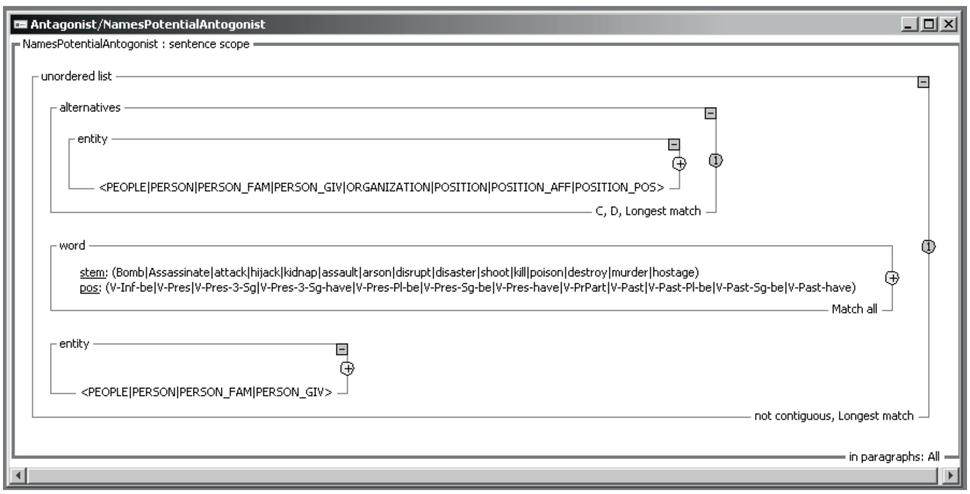


Figure 11.5 Text-mining rules created for the ESC *Antagonist*.

Means

Related to the Elementary Scenario Component *Means* we created one individual rule per weapon type value. We aim to extract incidents from a text where a specific weapon type (see figures below) is linguistically connected to a verb. Figure 11.6 is a visualisation of the rules that were created for the Elementary Scenario Component *Means*.

Figure 11.6 Text-mining rules created for the ESC *Means*.

Resistance

With respect to the Elementary Scenario Component *Resistance*, we created a broad rule to look for sentences with any of the words specified, in any form. Figure 11.7 is a visualisation of the rules that were created for the Elementary Scenario Component *Resistance*.

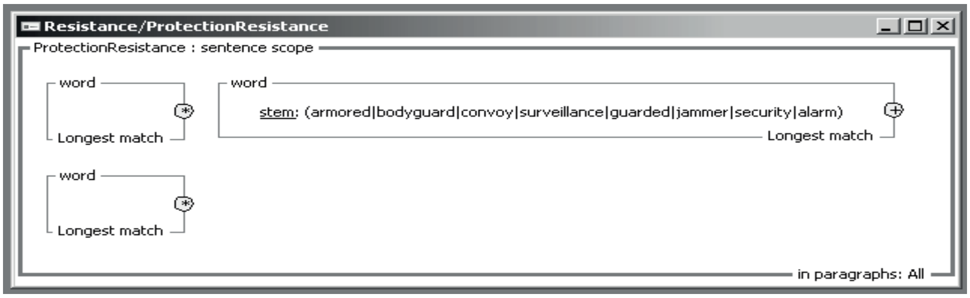


Figure 11.7 Text-mining rules created for the ESC *Resistance*.

11.3 Results of the experiment

Below we will present the results of the text-mining rules that were applied on the thirteen novels written by Frederick Forsyth. As this chapter aims to give an insight into the possibilities of text-mining techniques in the automatic extraction of the ESC12 variables, we will discuss different aspects of the obtained results. We will focus on qualitative as well as on quantitative results. Moreover, we will discuss general results that were obtained by applying the rules on all the thirteen novels, as well as concentrate on the results obtained from one specific novel.

As we assumed, *Day of the Jackal* is the most well known novel by Forsyth. So, when we specify our discussion to the results related to one individual novel, we refer to *Day of the Jackal*. For the reader's convenience, we added a summary of this novel as appendix E.

Below we will discuss results that were retrieved for the Elementary Scenario Components *Arena*, *Timeframe*, *Context*, *Antagonist*, *Means*, and *Resistance*.

Arena

The text-mining rules that were generated with respect to the Elementary Scenario Component *Arena* produced a sum total of 18,991 results out of the thirteen novels represented in the dataset. With respect to the story of *Day of the Jackal*, the rules presented 972 results. These results contained continents (i.e., "Africa"), countries (i.e., "Algiers"), addresses (i.e., "11 Rue des Saussaies"), and other location indicators (i.e., "Route Nationale Seven"). In figure 11.8 we have plotted the countries (viz. France, Algeria, Brittain, and Scotland[86]) and cities (Viz. Paris, London, Rome, Brussels, Marseille, Rennes, Copenhagen, and Milan) that play a prominent role in *Day of the Jackal*, on a map of Europe. (The size of the circles reflects the number of times a location is mentioned in the novel.)

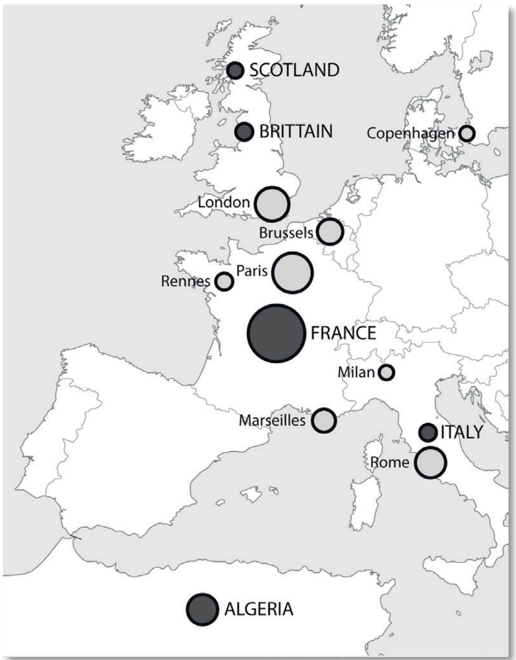


Figure 11.8 Text-mining results generated for the ESC *Arena*.

Analysis of the results for the Elementary scenario component *Arena* leads us to conclude that text mining indicates the main arena of *Day of the Jackal* to be France, and Paris in particular. Additionally, a significant link is suggested to Algeria, the United Kingdom (particularly to London) and Italy (particularly to

[86] We display the names of the countries are as they were mentioned in the novel *Day of the Jackal*.

Rome). To a lesser extent Brussels and Copenhagen seem to play a role in the novel *Day of the Jackal*.

Timeframe

For the Elementary Scenario Component *Timeframe* the text-mining rules retrieved total of 8,157 results out of the thirteen novels represented in the dataset. These results contained dates, days of the week, months, holidays, years, time periods, and times. For the novel *Day of the Jackal* 1,175 results were presented. Figure 11.9 lists the individual years that were mentioned in the novel, while figure 11.10 lists the different dates within a year. (The # symbol signifies the number of times the year / date was mentioned in the novel.)

Year	#
1961	16
1963	12
1960	10
1962	4
1940	3

Year	#
1944	3
1929	2
1956	2
1958	2
1959	2

Year	#
1931	1
1937	1
1942	1
1945	1
1946	1

Year	#
1953	1
1955	1
1957	1
1964	1
1968	1

Table 11.9 Text-mining results generated for the ESC *Arena*

Date	**#**
August	23
July	16
January	12
Monday	10
June	9
April	6
December	5
February	5
August 1st	4
June 15th	3
July 14th	3
July 22nd	3
April 3rd, 1929	2
June 30th	2
July 7th	2

Date	**#**
July 18th	2
July 29th	2
August 12th	2
August 22nd	2
August 15th	2
August 22nd, 1962	2
August 11th	2
August 25th, 1963	2
August 13th	2
January 14th	1
January 14th, 1963	1
February 14th	1
February 22nd	1
February 25th	1
March 4th	1

Date	**#**
March 8th	1
March 11th	1
March 11th, 1963	1
April 21st	1
June 12th	1
June 18th	1
June 18th, 1940	1
July first	1
July 1st	1
July 17th	1
July 28th	1
July 30th	1
July 31	1
July 31st	1
August 4th	1

Date	**#**
August 5th	1
August 14th	1
August 16th	1
August 20th	1
August 21st	1
August 23rd	1
August 24th	1
September 3rd	1
November 8th	1
November 8th, 1931	1
November	1
09-12-63	1
10-12-60	1
August 5th	1
August 14th	1

Table 11.10 Text-mining results generated for the ESC *Timeframe*.

Analysis of the aforementioned text-mining results, leads us to conclude that the timeframe of *Day of the Jackal* seems to be 1960 – 1963, whereas August (particularly between August 20th and 24th) seems to be especially relevant.

Context

The text-mining rules that were generated with respect to the Elementary Scenario Component *Context* returned a sum total of 6,728 results related to four types of contexts (viz. Economic, Personal, Political, and Religious). Because different contexts may play a role in a specific novel, we have marked the type of context with the highest appearance per title. Table 11.11 lists the results for the Elementary Scenario Component *Context*.

	Economic	Personal	Political	Religious	Grand Total
Avenger	73	116	162	45	396
Day of the Jackal	93	48	306	17	464
Icon	121	196	409	55	781
The Afghan	79	101	145	159	484
The Cobra	101	72	149	27	349
The Deceiver	69	110	251	44	474
The Devil's Alternative	71	66	559	33	729
The Dogs of War	376	49	220	21	666
The Fist of God	119	184	435	91	829
The Fourth Protocol	59	100	375	27	561
The Negotiator	129	67	347	102	645
The Odessa File	71	74	159	26	330
The Shepherd	3	4	9	4	20
Total	**1,364**	**1,187**	**3,526**	**651**	**6,728**

Table 11.11 Text-mining results generated for the ESC *Context*.

Analysis of the text-mining results depicted in table 11.11, leads us to conclude that the context of *Day of the Jackal* seems to be political.

Antagonist

For the Elementary Scenario Component *Antagonist*, the text-mining rules generated a total number of 2,226 qualitative results. To illustrate the nature of these results, we illustrate three pieces of texts that were retrieved from the novel *Day of the Jackal*.

- “... he (Rodin) will not even enter into operation until he (Rodin) has devised a plan that will enable him (Rodin) not only to complete the mission, but to escape unharmed. 'Do you estimate that such a plan could be worked out to permit a professional to kill …”
- “... assassinate him (Charles de Gaulle) …”
- “… he (Lebel) must have one qualification that marks him (Lebel) out... he (Lebel) would have to be one of the world's top professional contract-hire assassins... no, not a …”

The text-mining rules that we created, occasionally returned results that, by no means, relate to the Elementary Scenario Component *Antagonist*. Below we will reproduce one of such results, retrieved from the novel *Day of the Jackal*.

- "… she (MADAME LA BARONNE DE LA CHALONNIERE) could pass for five years younger, and sometimes felt ten years less than her age, the knowledge that her son was twenty and probably screwing his own women by now, no more to come home for the school holidays and go shooting …"

Quantifying the results that were retrieved from the novel *Day of the Jackal* leads to a list of 27 antagonists[87,88] that the protagonist of the story must confront.

Antagonist	Number of appearances
Lebel	37
Marc Rodin	19
Charles de Gaulle	18
Viktor Kowalski	10
Duggan	7
Trujillo	7
Calthrop	6
Monson	6
Francois	5
Marroux	5
Rolland	5
Brittany	4
Bouvier	4
Jean-Claude Dumas	4
Ministre	4

Antagonist	Number of appearances
Argoud	3
Bastien -Thiry	3
John F. Kennedy	3
Kovacs	3
"the bugger"	3
the General	2
Jean Paul Sartre	2
Grand Zohra	2
the Belgian	2
M. Roger Frey	2
Raoul Saint-Clair	2
Dr Mathieu	2
OTHER	21
GRAND TOTAL	**191**

Table 11.12 Text-mining results generated for the ESC *Antagonist*.

With respect to the novel *Day of the Jackal* we may conclude that analysis of the text-mining results suggests that the three main antagonists of *Day of the Jackal* are respectively: "Lebel", "Marc Rodin" and "Charles de Gaulle".

87 Because of the literary style of the novel *Day of the Jackal*, it is quite possible that an antagonist appears twice in table 11.12. For instance, "the bugger" may refer to one of the other antagonist mentioned in the table. Additionally, "the general" may refer to Charles de Gaulle.

88 In table 11.12 the antagonists that are mentioned less that two times in the novel, are accumulated in the category "other".

Means

The text-mining rules that were generated with respect to the Elementary Scenario Component *Means* returned a sum total of 2,700 results related to four types of contexts (viz. Explosive, Firearms, Incendiary Melee and Nuclear). Table 11.13 illustrates these results.

	Explosive	Firearms	Incendiary	Melee	Nuclear	Grand Total
Avenger	22	45		8	12	132
Day of the Jackal	11	192	2	1		398
Icon	17	64	3	1	9	158
The Afghan	38	55	2	2	4	156
The Cobra	13	28	4			73
The Deceiver	34	107		3	2	253
The Devil's Alternative	20	134		1	26	315
The Dogs of War	74	115			1	305
The Fist of God	135	108	4	3	82	440
The Fourth Protocol	30	25			57	137
The Negotiator	26	89		1	11	216
The Odessa File	31	41	1		2	116
The Shepherd	1					1
Total	**452**	**1,003**	**16**	**20**	**206**	**2,700**

Table 11.13 Text-mining results generated for the ESC *Means*.

With respect to the novel *Day of the Jackal* we may conclude that analysis of the text-mining results indicate that the weapons used most frequently, are related to the category “firearms”.

Resistance

For the Elementary Scenario Component *Resistance* we generated qualitative results. From the thirteen novels written by Frederick Forsyth, 898 instances were retrieved that are related to security measures. For the novel *Day of the Jackal*, the text-mining rules returned 99 instances. To illustrate these results, we will list the first 15 instances (related to security measures) that were retrieved for the novel *Day of the Jackal* in table 11.14.

1. The security men and guards stiffened in their boxes beside the front gate and the massive iron grilles were swung open.
2. Their son-in-law, Colonel Alain de Boissieu, then Chief of Staff of the armoured and cavalry units of the French Army, checked that both rear doors were safely shut, then took his place in the front beside Marroux.
3. Henri d'Jouder, the hulking bodyguard of the day, a Kabyle from Algeria, took the front seat beside the driver, eased the heavy revolver under his left armpit, and slumped back.
4. After a last word to one of the duty security men to be left behind, the second man got into the back alone.
5. He (Henri) was Commissaire Jean Ducret, chief of the presidential Security Corps.
6. Again the iron grille swung open and the small cortege swept past the ramrod guards into the Faubourg St Honor Arriving at the end of the Faubourg St Honore the convoy swept into the Avenue de Marigny.
7. Only the white of the motor-cycle sirens told traffic cops on duty of the approach of the convoy, and they had to wave and whistle frantically to get the traffic stopped in time.
8. The convoy picked up speed in the tree-darkened avenue and, erupted into the sunlit Place Clemenceau, heading straight across towards the Pont Alexandre III.
9. With the presidential car brought to a stop, the second OAS group would sweep out of a side road to blast the security police vehicle at close range.
10. Bougrenet de la Tocnaye would drive the car to intercept the security police, with Watin the Limp beside him (Bougrenet de la) clutching a submachine gun.
11. As the safety catches flicked off beside the road at Petit-Clamart, General de Gaulle's convoy cleared the heavier traffic of central Paris and reached the more open avenues of the suburbs.
12. The two motor-cycle outriders dropped back to take up station at the rear of the convoy.
13. In this manner the convoy entered the Avenue de la Division Leclerc at Petit Clamart.
14. At 8.18 Bastien-Thiry discerned the convoy hurtling down the Avenue de la Liberation towards him (8.18 Bastien-Thiry) at seventy miles per hour.
15. They opened up as the convoy came abreast of them, firing with a ninety-degree layoff at a moving target passing them at seventy miles per hour.

Table 11.14 Text-mining results generated for the ESC *Resistance*

If we combine the results of the text-mining rules that were applied to *Day of the Jackal*, we arrive at the conclusion that:

- The main arena is Paris, France, with a significant link to Algeria and London.
- The timeframe is 1960 – 1963, in which the month of August (particularly between August 20th and 24th) is particularly relevant.
- The context is political.
- The three main antagonists of *Day of the Jackal* are respectively: "Lebel", "Marc Rodin" and "Charles de Gaulle".
- The means the protagonist has to execute his plan is primarily a firearm.
- The protagonist has to overcome 99 defined security measures.

Referring to the summary of the Day of the Jackal provided in appendix E, we note that all of the aforementioned conclusions coincide with the text.

11.4 Chapter summary

In this chapter *Deletes scenes*, we provided a sneak preview of the possible future of the ESC12 scenario model, by addressing two claims that originated in our research, but did not directly relate to our scientific objective.

First, we addressed claim 1 *[A combination of data from terrorist incidents and works of fiction would enhance the potential of the ESC12 scenario model*]. To assess the value of this claim, we investigated the nexus between terroristic and creative narratives. We provided three examples of terrorist incidents that carried a strong resemblance with works of fiction. Moreover, we accumulated information from our research, with that of related scientific studies. Based on this preliminary assessment, we observe that claim 1 has a high degree of validity, and recommend it for further investigation.

Second, we addressed the claim 2 [*Text-mining techniques would enable the automatic extraction of the ESC12 variables from works of fiction*]. To assess the value of this claim, we set up a fairly straightforward experiment in which we applied text-mining techniques onto thirteen novels that were written by Frederick Forsyth. Based on the rules designed, we may conclude that text-mining techniques seem to allow for automatic extraction of the values of the ESC12 variables. Given the fact that (a) the recall of our text-mining algorithms may be improved by more elaborate rules, and (b) the precision of the results may be enhanced by experts in the field of law enforcement and information extraction, we believe that claim 2 has a high degree of validity, and recommend it for further examination.

Building on our preliminary assessment of both claims, we tentatively conclude that if (a) data from terrorist incidents and works of fiction enhances the potential of the ESC12 scenario model, and (b) text-mining enables the automatic extraction of the ESC12 variables from works of fiction, we would be able to increase the database of criminal behaviour exponentially.

If we allow ourselves to take a sneak preview of the future of the ESC12 scenario model, we imagine that before long:

- it will be possible to retrieve the values of the ESC12 variables automatically from written stories, audio, and video files. This would increase the number of incidents in the database from tens of thousands of terrorist incidents that actually did take place, to hundreds of thousands of incidents that have ever been recorded.

- if we are able to retrieve the values of the ESC12 variables from sources other that works of literature (sources such as the semantic web or online gaming), we will be able to feed the database with millions of incidents that have (and will be) created worldwide.
- if we create new scenarios by combining the individual values of the ESC12 variables from the incidents accumulated in the database, we will increase the incidents significantly.

Based on the information accumulated in this chapter, we provisionally conclude that when we start to retrieve values of the ESC12 variables form other sources than police databases, we move towards the point at which it would become rather hard to think of a criminal act that has neither been executed before, never been imagined and recorded, nor been generated by the ESC12 scenario model.

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Appendix A – List of regions used in PANDORA

1. North America
Canada, Mexico, United States
2. Central America & Caribbean
Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Nicaragua, Panama, Puerto Rico, St. Kitts and Nevis, Trinidad and Tobago, Virgin Islands (U.S.)
3. South America
Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela
4. East Asia
China, Hong Kong, Japan, Macau, North Korea, South Korea, Taiwan
5. Southeast Asia
Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, South Vietnam, Thailand, Timor-Leste, Vietnam
6. South Asia
Afghanistan, Bangladesh, Bhutan, India, Maldives, Mauritius, Nepal, Pakistan, Seychelles, Sri Lanka
7. Central Asia
Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan
8. Western Europe
Andorra, Austria, Belgium, Corsica, Denmark, East Germany (GDR), Finland, France, Germany, Gibraltar, Great Britain, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Man, Isle of, Netherlands, Northern Ireland, Norway, Portugal, Spain, Sweden, Switzerland, West Germany (FRG)
9. Eastern Europe
Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Czechoslovakia, Hungary, Kosovo, Macedonia, Moldova, Poland, Romania, Serbia-Montenegro, Slovak Republic, Slovenia, Yugoslavia
10. Middle East & North Africa
Algeria, Bahrain, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, North Yemen, Qatar, Saudi Arabia, South Yemen, Syria, Tunisia, Turkey, United Arab Emirates, West Bank and Gaza Strip, Western Sahara, Yemen
11. Sub-Saharan Africa
Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Kinshasa), Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rhodesia, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe
12. Russia & the Newly Independent States (NIS)
Armenia, Azerbaijan, Belarus, Estonia, Georgia, Latvia, Lithuania, Russia, Soviet Union, Ukraine
13. Australasia & Oceania
Australia, Fiji, French Polynesia, New Caledonia, New Hebrides, New Zealand, Papua New Guinea, Samoa (Western Samoa), Solomon Islands, Vanuatu, Wallis and Futuna

Appendix B – List of countries used in PANDORA

Afghanistan, Albania, Algeria, Andorra, Angola, Antigua & Deps, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia-Herzegovina, Botswana, Brazil, Brunei, Bulgaria, Burkina, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African, Rep., Chad, Chile, China, Colombia, Comoros, Congo, Congo {Democratic Rep}, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominica, Dominican Republic, East Timor, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland {Republic}, Israel, Italy, Ivory Coast, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Korea North, Korea South, Kosovo, Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Lesotho, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, {Burma}, Namibia, Nauru, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, St Kitts & Nevis, St Lucia, Saint Vincent & the Grenadines, Samoa, San Marino, Sao Tome & Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, Solomon Islands, Somalia, South Africa, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syria, Taiwan, Tajikistan, Tanzania, Thailand, Togo, Tonga, Trinidad & Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States of America, Uruguay, Uzbekistan, Vanuatu, Vatican City, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe, Unknown,

Appendix C – List of primary explosives used in PANDORA

For reasons of brevity, the list of primary explosives used in the PANDORA I and II databases are depicted below as values separated by a comma.

Acetylides of heavy metals, Aluminum containing polymeric propellant, Aluminum ophorite explosive, Amatex, Amatol, Ammonal, Ammonium nitrate explosive mixtures (cap sensitive), Ammonium nitrate explosive mixtures (non-cap sensitive), Ammonium perchlorate composite propellant, Ammonium perchlorate explosive mixtures, Ammonium picrate [picrate of ammonia, Explosive D], Ammonium salt lattice with isomorphously substituted inorganic salts, ANFO [ammonium nitrate-fuel oil], Aromatic nitro-compound explosive mixtures, Azide explosives, Baranol, Baratol, BEAF [1, 2-bis (2, 2-difluoro-2-nitroacetoxyethane)], Black powder, Black powder based explosive mixtures, *Blasting agents, nitro-carbo-nitrates, including non-cap sensitive slurry and water gel explosives, Blasting caps, Blasting gelatin, Blasting powder, BTNEC [bis (trinitroethyl) carbonate], BTNEN [bis (trinitroethyl) nitramine], BTTN [1, 2, 4 butanetriol trinitrate], Bulk salutes, Butyl tetryl, Calcium nitrate explosive mixture, Cellulose hexanitrate explosive mixture, Chlorate explosive mixtures, Composition A and variations, Composition B and variations, Composition C and variations, Copper acetylide, Cyanuric triazide, Cyclonite [RDX], Cyclotetramethylenetetranitramine [HMX], Cyclotol, Cyclotrimethylenetrinitramine [RDX], DATB [diaminotrinitrobenzene], DDNP [diazodinitrophenol], DEGDN [diethyleneglycol dinitrate], Detonating cord, Detonators, Dimethylol dimethyl methane dinitrate composition, Dinitroethyleneurea, Dinitroglycerine [glycerol dinitrate], Dinitrophenol, Dinitrophenolates, Dinitrophenyl hydrazine, Dinitroresorcinol, Dinitrotoluene-sodium nitrate explosive mixtures, "DIPAM [dipicramide; diaminohexanitrobiphenyl]", Dipicryl sulfone, Dipicrylamine, Display fireworks, DNPA [2, 2-dinitropropyl acrylate], DNPD [dinitropentano nitrile], Dynamite, EDDN [ethylene diamine dinitrate], EDNA [ethylenedinitramine], Ednatol, EDNP [ethyl 4, 4-dinitropentanoate], EGDN [ethylene glycol dinitrate], Erythritol tetranitrate explosives, Esters of nitro-substituted alcohols, Ethyl-tetryl, Explosive conitrates, Explosive gelatins, Explosive liquids, Explosive mixtures containing oxygen-releasing inorganic salts and hydrocarbons, Explosive mixtures containing oxygen-releasing inorganic salts and nitro bodies, Explosive mixtures containing oxygen-releasing inorganic salts and water insoluble fuels, Explosive mixtures containing oxygen-releasing inorganic salts and water soluble fuels, Explosive mixtures containing sensitised nitromethane, Explosive mixtures containing tetranitromethane (nitroform), Explosive nitro compounds of aromatic hydrocarbons, Explosive organic nitrate mixtures, Explosive powders, Flash powder, Fulminate of mercury, Fulminate of silver, Fulminating gold, Fulminating mercury, Fulminating platinum, Fulminating silver, Gelatinised nitrocellulose, Gem-dinitro aliphatic explosive mixtures, Guanyl nitrosamino guanyl tetrazene, Guanyl nitrosamino guanylidene hydrazine, Guncotton, Heavy metal azides, Hexanite, Hexanitrodiphenylamine, Hexanitrostilbene, Hexogen [RDX], Hexogene or octogene and a nitrated N-methylaniline, Hexolites, HMTD [hexamethylenetriperoxidediamine], "HMX [cyclo-1, 3, 5, 7-tetramethylene 2, 4, 6, 8-tetranitramine; Octogen]", Hydrazinium nitrate/hydrazine/aluminum explosive system, Hydrazoic acid, Igniter cord, Igniters, Initiating tube systems, KDNBF [potassium dinitrobenzo-furoxane], Lead azide, Lead mannite, Lead mononitroresorcinate, Lead picrate, Lead salts, explosive, Lead styphnate [styphnate of lead, lead trinitroresorcinate], Liquid nitrated polyol and trimethylolethane, Liquid oxygen explosives, Magnesium ophorite explosives, Mannitol hexanitrate, MDNP [methyl 4, 4-dinitropentanoate], MEAN [monoethanolamine nitrate], Mercuric fulminate, Mercury oxalate, Mercury tartrate, Metriol trinitrate, Minol-2 [40% TNT, 40% ammonium nitrate, 20% aluminum], "MMAN [monomethylamine nitrate]; methylamine nitrate", Mononitrotoluene-nitroglycerin mixture, Monopropellants, NIBTN [nitroisobutametriol trinitrate], Nitrate explosive mixtures, Nitrate sensitised with gelled nitroparaffin, Nitrated carbohydrate explosive, Nitrated glucoside explosive, Nitrated polyhydric alcohol explosives, Nitric acid and a nitro aromatic compound explosive, Nitric acid and carboxylic fuel explosive, Nitric acid explosive mixtures, Nitro aromatic explosive mixtures, Nitro compounds of furane explosive mixtures, Nitrocellulose explosive, Nitroderivative of urea explosive mixture, Nitrogelatin explosive, Nitrogen trichloride, Nitrogen tri-iodide, Nitroglycerine, trinitroglycerine], Nitroglycide, Nitroglycol [ethylene glycol dinitrate, EGDN], Nitroguanidine explosives, Nitronium perchlorate propellant mixtures, Nitroparaffins Explosive Grade and ammonium nitrate mixtures, Nitrostarch, Nitro-substituted carboxylic acids, Nitrourea, Octogen [HMX], Octol [75 percent HMX, 25 percent TNT], Organic amine nitrates, Organic nitramines, PBX [plastic bonded explosives], Pellet powder, Penthrinite composition, Pentolite, Perchlorate explosive mixtures, Peroxide based explosive mixtures, PETN [nitropentaerythrite, pentaerythrite tetranitrate, pentaerythritol, tetranitrate], Picramic acid and its salts, Picramide, Picrate explosives, Picrate of potassium explosive mixtures, Picratol, Picric acid (manufactured as an explosive), Picryl chloride, Picryl fluoride, PLX [95% nitromethane, 5% ethylenediamine], Polynitro aliphatic compounds, Polyolpolynitrate-nitrocellulose explosive gels, Potassium chlorate and lead sulfocyanate explosive, Potassium nitrate explosive mixtures, Potassium nitroaminotetrazole, Pyrotechnic compositions, PYX [2, 6-bis(picrylamino)]-3, 5-dinitropyridine, "RDX [cyclonite, hexogen, T4, cyclo-1, 3, 5, -trimethylene-2, 4, 6, -trinitramine; hexahydro-1, 3, 5-trinitro-S-triazine]", Safety fuse, Salts of organic amino sulfonic acid explosive mixture, Salutes (bulk), Silver acetylide, Silver azide, Silver fulminate, Silver oxalate explosive mixtures, Silver styphnate, Silver tartrate explosive mixtures, Silver tetrazene, Slurried explosive mixtures of water, inorganic oxidizing salt, gelling, agent, fuel, and sensitizer (cap sensitive), Smokeless powder, Sodatol, Sodium amatol, Sodium azide explosive mixture, Sodium dinitro-ortho-cresolate, Sodium nitrate explosive mixtures, Sodium nitrate-potassium nitrate explosive mixture, Sodium picramate, Special fireworks, Squibs, Styphnic acid explosives, Tacot [tetranitro-2, 3, 5, 6-dibenzo- 1, 3a, 4, 6a tetrazapentalene], TATB [triaminotrinitrobenzene], TATP [triacetonetriperoxide], TEGDN [triethylene glycol dinitrate], Tetranitrocarbazole, Tetrazene [tetracene, tetrazine, 1(5-tetrazolyl)-4-guanyl tetrazene, hydrate], Tetryl [2, 4, 6 tetranitro-N-methylaniline], Tetrytol, Thickened inorganic oxidizer salt slurried explosive mixture, TMETN [trimethylolethane trinitrate], TNEF [trinitroethyl formal], TNEOC [trinitroethylorthocarbonate], TNEOF [trinitroethylorthoformate], TNT [trinitrotoluene, trotyl, trilite, triton], Torpex, Tridite, Trimethylol ethyl methane trinitrate composition, Trimethylolthane trinitrate-nitrocellulose, Trimonite, Trinitroanisole, Trinitrobenzene, Trinitrobenzoic acid, Trinitrocresol, Trinitro-meta-cresol, Trinitronaphthalene, Trinitrophenetol, Trinitrophloroglucinol, Trinitroresorcinol, Tritonal, Urea nitrate, Water-bearing explosives having salts of oxidizing acids and nitrogen bases, sulfates, or sulfamates Water-in-oil emulsion explosive compositions, Xanthamonas hydrophilic colloid explosive mixture, Combination of, Unknown,

Appendix D – Data collection of lone-operator incidents in PANDORA

Ref #	Date	Attempt/ attack	Summary
			FIRST WAVE OF MODERN TERRORISM
1	11-05-1878	Attempt	Max Hodel attempts to assassinate Kaiser Wilhelm I of Germany by shooting him. He fails twice, is apprehended and executed
2	04-08-1878	Attack	Sergey Stepnyak-Kravchinsky stabs General Nikolai Mezentsov, head of the Tsar's secret police, to death in response to the execution of Ivan Kovalsky
3	feb. 1879	Attack	Grigori Goldenberg shoots Prince Dmitri Kropotkin, the Governor of Kharkov in the Russian Empire, to death
4	20-04-1879	Attempt	Alexander Soloviev attempts to assassinate Tsar Alexander II of Russia. The monarch spots the weapon in his hands and flees, but Soloviev still fires five shots, all of which miss. He is captured and hanged on May 28
5	17-02-1880	Attempt	Stepan Khalturin successfully blows up part of the Winter Palace in an attempt to assassinate Tsar Alexander II of Russia. Although the Tsar escaped unharmed, eight soldiers were killed and 45 wounded
6	01-03-1881	Attack	Czar Alexander II is assassinated with home made explosives, by Ignacy Hryniewiecki, a member of the revolutionary Russian party Narodnaya Volya[89].
7	23-07-1892	Attempt	Alexander Berkman tries to kill American industrialist Henry Clay Frick in retaliation for Frick's hiring of Pinkerton detectives to break up the Homestead Strike, resulting in the deaths of seven steelworkers. Although badly wounded, Frick survives, and Berkman is arrested and eventually sentenced to 22 years in prison
8	09-12-1893	Attack	Auguste Vaillant throws a nail bomb in the French National Assembly, killing nobody and injuring one. He is then sentenced to death and executed by the guillotine on February 4, 1894, shouting "Death to bourgeois society and long live anarchy!" (A mort la société bourgeoise et vive l'anarchie!). During his trial, Vaillant declared that he had not intended to kill anybody, but only to injure several deputies in retaliation against the execution of Ravachol, who had engaged himself in four bombings"
9	12-02-1894	Attack	Émile Henry, intending to avenge Auguste Vaillant, sets off a bomb in Café Terminus (a café near the Gare Saint-Lazare train station in Paris), killing one and injuring twenty
10	24-06-1894	Attack	After delivering a speech in Lyon Sadi Carnot, the president of France is stabbed to death by Italian anarchist Sante Geronimo. Caserio described the assassination as a political act.
11	03-11-1896	Attack	"In the Greek city of Patras, Dimitris Matsalis, an anarchist shoemaker, attacks banker Dionysios Fragkopoulos and merchant Andreas Kollas with a knife. Fragkopoulos is killed on the spot. Kollas is seriously wounded"
12	08-08-1897	Attack	Michele Angiolillo shoots Spanish prime-minister Antonio Cánovas del Castillo dead at a thermal bath resort, seeking vengeance for the imprisonment and torture of alleged revolutionaries at the Montjuïc fortress.
13	10-09-1898	Attack	Luigi Lucheni stabs Empress Elisabeth, the consort of Emperor Franz Joseph I of Austria-Hungary, to death with a needle file in Geneva, Switzerland. Lucheni is sentenced to life in prison and eventually commits suicide in his cell

[89] We note that the assassination of Czar Alexander is -by some sources- attributed to two or three protagonists. We reiterate that, our definition of lone operators includes protagonists that work in small networks or autonomous cells, (see definition 2.4).

14	29-07-1900	Attack	Gaetano Bresci shoots King Umberto I of Italy dead, seeking revenge for the Bava-Beccaris massacre in Milan. Due to the lack of capital punishment in Italy, Bresci is sentenced to penal servitude for life on Santo Stefano Island, where is found dead less than a year later
15	06-09-1901	Attack	Leon Czolgosz shoots U.S. president William McKinley at point-blank range at the Pan-American Exposition in Buffalo, New York. McKinley dies on September 14, and Czolgosz is executed by electric chair on October 29
16	15-11-1902	Attempt	Gennaro Rubino attempts to murder King Leopold II of Belgium as he returns in a procession from a memorial service for his recently-deceased wife, Marie Henriette. All three of Rubino's shots miss the monarch's carriage, and he is quickly subdued by the crowd and taken into police custody. He is sentenced to life imprisonment and dies in prison in 1918
17	31-05-1906	Attempt	Catalan anarchist Mateu Morral tries to kill King Alfonso XIII of Spain and Princess Victoria Eugenie of Battenberg after their wedding by throwing a bomb into the wedding procession following the ceremony. The monarchs are unhurt, but some bystanders and horses are killed. Morral is apprehended two days later and commits suicide while being transferred to prison
18	01-02-1908	Attack	Manuel Buíça and Alfredo Costa shoot to death King Carlos I of Portugal and his son, Crown Prince Luis Filipe, respectively, in the Lisbon Regicide. Both Buiça and Costa, who were both eventually shot dead by police officers, were sympathetic to a republican movement in Portugal that included anarchist elements
19	28-03-1908	Attempt	Anarchist Selig Cohen aka Selig Silverstein tries to throw a bomb in New York City's Union Square. A premature explosion kills a bystander named Ignatz Hildebrand and mortally wounds Cohen, who dies a month later
20	01-09-1911	Attack	Dmitri Bogrov shoots Russian prime-minister Pyotr Stolypin at the Kiev Opera House in the presence of Tsar Nicholas II and two of his daughters, Grand Duchesses Olga and Tatiana. Stolypin dies four days later, and Bogrov is hanged on September 28
21	12-11-1912	Attack	Spanish prime-minister Canalejas was shot to death by a Spanish anarchist who committed suicide right after his act.
22	18-03-1913	Attack	While on an afternoon walk, King George I of Greece was shot dead at close range in the back by Alexandros Schinas, a member of a socialist organisation who claimed that the King had refused to give him money.
23	22-08-1922	Attack	Michael Collins, IRA leader, killed in an ambush firefight near the end of Irish Civil War
24	16-12-1922	Attack	First Polish president Gabriel Narutowicz. Killed five days after his inauguration, while attending the opening of an art exhibit at the Zach_ta Gallery in Warsaw
25	25-03-1926	Attack	Head of the Ukrainian People's Republic, Petliuara was shot to death while walking in Paris by a Sholom Schwartzbard a Russian Jewish anarchist and poet.
26	01-04-1926	Attempt	Attempt to assassinate Italian president Benito Mussolini by Violet Gibson

			SECOND WAVE OF MODERN TERRORISM
27	17-07-1928	Attack	Mexican president Obregón was shot in a café where he was celebrating his electoral victory by anti-governmental roman catholic José de León Toral who blamed Obregón for the Mexican government's atrocities against the Catholic Church.
28	06-03-1933	Attack	Anton Cermak, Mayor of Chicago, killed in Miami, Florida during a visit of president-elect of Franklin Roosevelt
29	08-11-1932	Attack	Afghan King Mohammed Shah was shot to death by ethnic Hazara, Abdul Khaliq, a teenage boy while attending a high school graduation ceremony.
30	30-04-1933	Attack	Peruvian president Sanchez was killed when reviewing recruits at Santa Beatrice racetrack by a member of a supressed political party Abelardo de Mendoza.

31	09-10-1934	Attack	First king of Yugoslavia, Alexander I of Yugoslavia, killed in Marseille during a state visit by a member of the International Macedonian Revolutionary Organization (IMRO
32	10-09-1935	Attack	Governor Huey Long was shot to death by Dr. Carl Weiss, the son-in-law of one of his most prominent political opponents.
33	21-08-1940	Attack	Ramon Mercader, sent by the Russian secret police, killed Lev Bronstein Trotsky, by a pick-hit on his head
34	17-05-1941	Attempt	Attempt by Vasil Laci to kill Victor Emmanuel III, King of Italy and member of the House of Savoy
35	01-06-1942	Attack	SS-Obergruppenführer Reinhard Heydrich, shot by Jan Kubi_ and Jozef Gab_ík
36	20-07-1944	Attempt	Chancellor and Führer of Germany Adolf Hitler Narrowly escapes in the July 20 plot, initiated by Claus von Stauffenberg
37	09-04-1947	Attack	Leader of the populist movement in Colombia, and former minister Gaitán was running for the preseidential elections when he was assassinated after a lunch with friends. The murderer was killed by an enraged mob and the motives behind the killing remained unclear.
38	30-01-1948	Attack	Gandhi, the preeminent leader of Indian nationalism in British-ruled India. was shot on his way to a prayer meeting by Nathuram Godse, a Hindu nationalist who held Gandhi guilty of favouring Pakistan and strongly opposed his doctrine of nonviolence.
39	09-04-1948	Attack	Leader of the populist movement in Colombia, and former minister Gaitán was running for the presidential elections when he was assassinated after a lunch with friends. The alleged murderer Juan Roa Sierra, was killed by an enraged mob and the motives behind the killing remained unclear.
40	01-11-1950	Attempt	Attempt to kill US president Harry S. Truman in order to draw attention to the Puerto Rico independence movement, in which both attempted killers were active.
41	16-10-1951	Attack	Ali Khan was shot while addressing a gathering of 100,000 in Municipal Gardens, Rawalpindi, Pakistan by Saad Akbar Babrak, an Afghan national and a professional assassin. The assassination has never been investigated properly.
42	26-07-1957	Attack	Castillo Armas was killed while taking a stroll with his wife by Romeo Vásquez, a palace guard who was found dead a short while later. The motivations behind the killing remain unclear.
43	29-09-1956	Attack	Nicaraguan president Somoza was shot to death at a campaign reception by Rigoberto López Pérez, a Nicaraguan poet and music composer. The assassin died in a hail of bullets and little is known about his motivation.
44	26-09-1959	Attack	Prime-minister of Sri Lanka Solomon Bandaranaike, Assassinated by a Buddhist monk as part of a conspiracy
45	13-05-1960	Attempt	"Fidel Castro, Cuban leader. Attempts to introduce poison supplied by the CIA into Castro's food. Castro supposedly survived 638 assassination attempts in all
46	12-10-1960	Attack	Inejiro Asanuma, member of Japanese Socialist Party. Asanuma was pierced to assassin's bayonet while making a speech
47	11-12-1960	Attempt	Attempt to assassinate US president-elect John F. Kennedy by lone wolf Richard Paul Pavlick
48	27-02-1962	Attempt	An attempt to kill President of the Republic of Vietnam Ngo Dinh Diem in the 1962 South Vietnamese presidential palace bombing fails
49	22-08-1962	Attempt	Attempt to kill French president Charles de Gaulle by Jean Bastien-Thiry and the OAS
50	06-09-1966	Attack	Prime-minister Hendrik Verwoerd was stabbed in the neck and chest in the House of Assembly by an uniformed parliamentary messenger Dimitri Tsafendas who claimed to have been motivated by outrage for Verwoerds racial policy.

THIRD WAVE OF MODERN TERRORISM			
51	22-11-1963	Attack	US president John F. Kennedy, was travelling in a presidential motorcade in Dallas, Texas, when he was shot to death with a long range firearm. Lee Harvey Oswald was charged with the assassination of Kennedy. He denied but was killed by Jack Ruby on November 24, before he could be indicted or tried.
52	15-05-1966	Attack	President of El Salvador Hernández, was stabbed to death at age 84, by his driver Cipriano Morales whose father had been one of the many murdered by Hernández's dictatorship.
53	04-04-1968	Attack	Martin Luther King, leader of the Afro-American Civil Rights movement was shot to death with a long range firearm by James Earl Ray, while standing on the balcony of his hotel room.
54	11-04-1968	Attempt	German student movement leader Rudi Dutschke was shot in the head, while getting on his bike by a young anti-communist Josef Bachmann. Dutschke survived the attack and died 11 years later, reportedly because of the brain damage sustained in the assassination attempt.
55	05-06-1968	Attack	Presidential candidate Robert F. Kennedy, was shot while walking through a hotel kitchen by Shirhan Shirhan, a 24-year-old Palestinian Jordanian citizenship, ostensibly because of the senator's advocacy of U.S. support for Israel.
56	11-09-1973	Attack	Salvador Allende Gossens, president of Chile, killed by the Chilean Army
57	21-03-1983	Attack	Benigno (Ninoy) Aquino Jr., Politician, Fillippines, killed by the Army
58	10-10-1986	Attack	Gerald (Gero) Hermann Johannes Von Braunmuhl, German diplomate, killed by the Rote Armee Fraktion
59	25-03-1975	Attack	King Faisal was assassinated by his cousin Prince Faisal, while he was greeting him in his palace in Riyadh. Prince Faysal reportedly wanted to avenge the death of his brother Prince Khalid who was shot by a policeman.
60	07-04-1979	Attack	Siegfried Buback, German General prosecutor, assassinated by the RAF
61	10-05-1979	Attack	Roque Dalton, Writer, El Salvador, Regime executed
62	01-11-1963	Attack	Ngo Dinh Diem, Politican, South Vietnam, assassinated by the Vietnamese army
63	10-11-1979	Attack	Gunter Von Drenkmann, president of the Berlin Court, killed by the RAF
64	11-04-1968	Attack	Alfred Will Rudolf Dutschke, German student leader, shot in his head on the street while leaving his house. Survived the attempt but died ten years after the incident due to brain damage caused by the attack
65	11-06-1963	Attack	Medgar W. Evers, American civil rights fighter, killed by the Ku Klux Klan
66	25-03-1975	Attack	King Faisal of Saudi Arabia, was assassinated by his cousin Prince Faisal bin Musaid while he was greeting him in his palace in Riyadh. Prince Faysal reportedly wanted to avenge the death of his brother Prince Khalid who was shot by a policeman.
67	06-05-1978	Attack	Larry Flint, American director of porn, shot when he was leaving the court building by sniper Joseph Paul Franklin
68	22-09-1975	Attempt	Gerald Rudolph Ford, president of the USA, two attempts on his life by different women
69	31-10-1984	Attack	Indira Shrimati Gandhi, Indian politician, stabbed in the chest by own guards, attributed to the Sikhs
70	1958 - 1966	Numerous Attempts	Charles Andre Joseph Marie de Gaulle, president of France
71	30-11-1989	Attack	Alfed Herrhausen, German banker, kidnapped and killed by the RAF
72	11-05-1981	Attack	Heinz-Herbert Karry, German politician killed by RZ
73	22-11-1963	Attack	John Fitzgerald Kennedy, president of the US, assassinated by Harvey Lee Oswald while he was traveling in a presidential motorcade in Dallas, Texas
74	15-06-1968	Attack	Robert Francis Kennedy, American politician and US presidential candidate, was shot by Sirhan, a Jordanian immigrant, while he was walking through the

			kitchen of the Ambassador Hotel in Los Angeles to celebrate his electoral victory
75	03-04-1968	Attack	Martin Luther King, American civil rights activist, was killed while standing on the balcony of his hotel room in Memphis. Shot by James Earl Ray, who was captured two months after the shooting
76	08-12-1980	Attack	Mark Chapman shot John Lennon, British musician and front man of popular band The Beatles, on the entrance of the building where he lived on December 8, 1980
77	18-01-1961	Attack	Patrice Hemery Lumumba, Congolese politician, killed by the army
78	21-02-1965	Attack	Malcolm (X) Little, American civil rights activist, allegedly killed by organization Black Muslim
79	27-11-1975	Attack	Ross McWrither, producer of Guinness Book of Records, kidnapped and killed by the IRA
80	16-03-1978	Attack	Aldo Moro, Italian politician, assassinated by the Brigate Rosse
81	27-08-1979	Attack	Louis Mountbatten, First Earl of Burma, kidnapped and assassinated by the IRA
82	28-08-1968	Attack	Sven Olof Palme, Swedish president, unknown perpetrator
83	06-03-1978	Attack	Larry Flynt, American publisher of porn magazines, was shot by white-supremacist serial killer Joseph Paul Franklin with a long range firearm, while he was leaving the court building with his lawyer, after a legal battle related to obscenity.
84	16-10-1979	Attack	Park Tsjoeng Hee, South-Korean General and politician, killed by the KCIA
85	30-07-1977	Attack	Jorgen Ponto, German banker, kidnapped and assassinated by the RAF
86	1978 - 1995	Attack	"Theodore ""Ted"" Kaczynski (also known as the Unabomber (university and airline bomber), is an American mathematician, social critic and primitivist, who engaged in a mail bombing spree that spanned nearly 20 years, killing three people and injuring 23 others."
87	1980 - 1981	Attack	"Joseph Christopher was an American serial killer who was active from September 22, 1980 until his arrest on May 10, 1981. He was known as the "".22-Caliber Killer"" and the ""Midtown Slasher."" It is believed that he killed twelve individuals and wounded numerous others, almost all of them African American with one Hispanic male."
88	08-12-1980	Attack	"Singer / songwriter John Lennon was shot to death by Mark Chapman, a "fan" who became obsessed with the musician. Upon arrest the killer stated ""I'm sure the big part of me is Holden Caulfield, who is the main person in the book [The catcher un the Rye]."""

			FOURTH WAVE OF MODERN TERRORISM
89	19-10-1984	Attack	Jerzy Popieluszko, Polish catholic theologian, killed by the regime
90	29-03-1981	Attempt	Ronald Wilson Reagan, president of the US, was struck by gunfire from would-be assassin John Hinckley, outside the Washington Hilton hotel. Although close to death during surgery, Reagan survived the assassination attempt
91	06-10-1981	Attack	Mohammed Anwar al-Sadat, president of Egypt, killed by the Muslim Brotherhood
92	05-09-1977	Attack	Hanns-Martin Schleyer, German businessman, assassinated by the RAF
93	17-09-1980	Attack	Anastasio Somoza Debayle, president of Nicaragua, unknown perpetrator
94	30-05-1961	Attack	Rafael Leonidas Trujillo Y Molina, Dominican Republic politician, assassinated by the CIA
95	15-05-1972	Attempt	George Corley Wallace, US governor and presidential candidate, lone wolf, survived attack
96	12-10-1990	Attempt	German Federal Minister of the Interior Wolfgang Schäuble was shot in back and face after an election campaign event in Oppenau by Dieter Kaufmann. Has been paralysed and using a wheelchair ever since
97	17-02-1991	Attempt	British prime-minister John Major, attacked by IRA. Mortar attack during a meeting at 10 Downing Street

98	21-05-1991	Attack	Former Indian prime-minister Rajiv Gandhi. Killed in an explosion triggered by a LTTE suicide bomber. First head of state to be killed by a suicide bomber
99	10-04-1993	Attack	South African Communist Party leader Chris Hani, killed by Janusz Walus in an anti-communist killing
100	01-05-1993	Attack	Sri Lankan president Ranasinghe Premadasa.
101	1993 -1997	Attack	Between 1993 en 1997 Franz Fuchs killed four people and injured 15 against foreigners and people who were friendly to foreigners with three improvised explosive devices (IEDs) and five waves of 25 mail bombs in total.
102	23-03-1994	Attack	Mexican Candidate Luis Donaldo Colosio was killed by Alberto Martinez in what is widely believed to be a conspiracy by the Mexican president at the time
103	24-02-1994	Attack	Baruch Goldstein, a former member of the Jewish Defence League and follower of the Kahanist movement,[7] opened fire inside the Cave of the Patriarchs in Hebron, killing 29 people and injuring at least 100.[8]
104	06-04-1994	Attack	Rwandan president Juvénal Habyarimana and Burundian president Cyprien NtaryamiraPlane carrying the two leaders shot down by unknown attackers with a surface-to-air missile. The attack was the catalyst for the Rwandan Genocide.
105	06-01-1995	Attempt	Attempt to kill Pope John Paul II by Ramzi Yousef, part of Operation Bojinka. A large-scale planned Islamist terrorist attack to blow up 12 airliners and 4,000 passengers
106	04-11-1995	Attack	Rabin was assassinated attending a mass rally in Tel Aviv, held in support of the Oslo Accords, by a radical right-wing Orthodox Jew Yigal Amir, who opposed the signing of the these accords.
107	30-11-1999	Attempt	Attempt to kill George Harrison, lead guitarist of popular band The Beatles, by Michael Abram. Abram broke into Harrison's house and repeatedly stabbed him
108	April 1999	Attack	David Copeland, an English Neo-Nazi militant executed a 13-day bombing campaign in April 1999 aimed at London's black, Bangladeshi and gay communities that resulted in three deaths and more than a hundred injured.
109	10-08-1999	Attack	White-supremacist Buford Furrow, Jr. walked into the lobby of the North Valley Jewish Community Center and opened fire with a semiautomatic weapon. The gunfire wounded three children, a teenage counselor, and an office worker.
110	22-02-2000	Attack	Member of the Basque Parliament Fernando Buesa, killed by ETA
111	01-06-2001	Attack	King Birendra of Nepal and other royal family members of same country were killed by his son, Prince Dipendra in what is known as the Nepalese royal massacre
112	06-05-2002	Attack	Nine days before the general election in the Netherlands, Fortuyn was shot to death in a parking lot outside a radio studio where he had just given an interview. The environmental activist Volkert van der Graaf that shot him, claimed that he had become alarmed that Fortuyn was using Muslims and immigrants as scapegoats in a campaign to seek political power.
113	14-07-2002	Attempt	French president Jacques Chirac was almost killed by Macime Brunerie. Brunerie attempted to shoot the president during the Bastille Day Military Parade
114	11-09-2003	Attack	Swedish Foreign Minister Anna LindhLindh was attacked while shopping in a department store in central Stockholm. She was stabbed in the chest, abdomen and arms. The attacker Mijailo Mijailovi_ reportedly had serious mental problems, and had previously been convicted of violent crimes. His motive was not considered political.
115	12-03-2003	Attack	"Serbian prime-minister Zoran _in_i_ was killed by Zvezdan Jovanovi_. Jovanovi_ killed his victim with a sniper rifle
116	19-03-2004	Attempt	President of Republic of China Chen Shui-bian was shot by Chen Yi-hsiung in what is known as the
117	09-05-2004	Attack	President of Chechnya Akhmad Kadyrov was killed along with about 30

			others in a football stadium during a Soviet Victory Day parade, by a bomb that had been built into the concrete of one of the stadium's supporting columns. Presumably by Chechen Islamists
118	14-02-2005	Attack	Former Lebanese prime-minister and billionaire Rafik Hariri, assassination via car bomb in Beirut. Allegedly by Hezbollah and Syrian intelligence services
119	10-05-2005	Attempt	U.S. president George W. Bush and Georgian president Mikheil Saakashvili. Attempt by Arutyunian, who threw a hand grenade at Bush, which failed to detonate
120	04-08-2005	Attack	Eden Natan-Zada, an alleged Kahanist, killed four Israeli Arabs on a bus and wounded 12 before being killed by other passengers.[11] Natan-Zada was a 19-year-old soldier who had deserted his unit after he refused to remove settlers from the Gaza Strip. Less than two weeks later, on August 17, 2005, Asher Weisgan, a 40-year old Israeli bus-driver, shot and killed four Palestinians and injured two others in the West Bank settlement of Shiloh.
121	07-10-2006	Attack	"Journalist Anna Politkovskaya, shot in the elevator block of her apartment in Moscow. Unknown perpetrator
122	04-09-2006	Attack	Nabil Ahmad Jaoura, a Jordanian of Palestinian origin, opened fire on tourists at the Roman Amphitheatre in Amman, Jordan. One British tourist died and six others, including five tourists, were injured. Police said he was not connected with any organized group but was angered by Western and Israeli actions in the Middle East.[12]
123	23-11-2006	Attack	Former FSB officer Alexander Litvinenko was killed by Acute radiation syndrome via ingestion of polonium-210. Perpetrators unknown, though believed to be figures within the government of Russia
124	27-12-2007	Attack	Former prime-minister of Pakistan and Pakistan Peoples Party Chair and Opposition Leader Benazir Bhutto. Killed while entering a vehicle upon leaving a political rally for the Pakistan People's Party in Rawalpindi, Pakistan. Perpetrators unknown, widely believed to be Islamic militants
125	02-07-2008	Attack	An Arab resident of east Jerusalem Hussam Taysir Duwait attacked several cars on Jaffa Road in Jerusalem using a front-end loader (erroneously referred to as a bulldozer in the media), killing three people and wounding at least thirty pedestrians, before being shot to death. A motive for the attack could not immediately be determined, but police at the scene referred to the incident as a terrorist attack.
126	02-03-2009	Attack	President of Guinea-Bissau João Bernardo Vieira was hacked to death during armed attack on his residence in Bissau by the army
127	30-04-2009	Attempt	During the celebration of Queen's Day in the Netherlands, Karst Tates drove his car at high speed into a parade that included members of the Royal Family of the Netherlands. The vehicle drove through a line of people watching the parade, resulting in eight deaths and ten injuries. It missed the Royal Family and crashed into a monument at the side of the road. No members of the Royal Family were harmed.
128	01-06-2001	Attack	In the Little Rock recruiting office shooting American born Carlos Leon Bledsoe, (who converted to Islam and was named Abdulhakim Mujahid Muhammad), opened fire with a rifle in a drive-by shooting on soldiers in front of a United States military recruiting office in Little Rock, Arkansas. He killed Private William Long, and wounded Private Quinton Ezeagwula.
129	05-11-2009	Attack	The Fort Hood shooting is considered a jihadist mass murder that took place on November 5, 2009, at Fort Hood, Texas when a U.S. Army major and psychiatrist Nidal Malik Hasan, fatally shot 13 people and injured more than 30 others.
130	19-01-2010	Attack	"Mahmoud al-Mabhouh, senior Hamas military commander. Exact cause unknown
131	18-02-2010	Attack	"Andrew Joseph Stack III, crashed his Piper Dakota into Building I of the Echelon office complex in Austin, Texas, United States, killing himself and Internal Revenue Service (IRS) manager Vernon Hunter. Thirteen others were

			injured, two seriously. The Internal Revenue Service (IRS) field office was located in a four-story office building, along with other state and federal government agencies and some private businesses on the first floor. Prior to the crash, Stack had posted a suicide note referring to ""greed"" with the IRS, dated February 18, 2010, to his business website."
132	14-09-2010	Attempt	Missouri Governor Jay Nixon was stabbed by Casey Brezik. He mistakenly stabbed a college dean in a hallway by a lecture where Nixon was to speak. Brezik told police that he thought he had stabbed Nixon
133	04-01-2011	Attack	Salmaan Taseer, 26th Governor of Punjab was shot to death by one of his bodyguards that shot him 27 times with a sub-machine gun as he was returning to his car after meeting a friend for lunch in Islamabad. His assassin Malik Mumtaz Hussain Qadri reportedly said he killed Taseer because of the latter's vocal opposition to the blasphemy law in Pakistan.
134	08-01-2011	Attempt	Gabrielle Giffords, U.S. Representative from Arizona. Shot, along with several staffers and U.S. District Judge John Roll (killed), at a constituent event in her district by Jared Lee Loughner. There were a total of at least 6 deaths and 12 injured
135	02-03-2011	Attack	Shahbaz Bhatti, Federal Minister for Minorities of Pakistan. Killed due to his opposition to Pakistan's blasphemy laws by the Taliban
136	02-03-2011	Attack	"Arid Uka is a Muslim Kosovo Albanian from Frankfurt am Main, On 2 March 2011 he murdered two U.S. Airmen and severely wounded two others at Frankfurt Airport. This incident is considered to be the first successful assassination in Germany with an Islamist background. Shouting Allahu akbar (""God is great"") Uka fired with a pistol on unarmed US Airmen and the driver of a bus of the military services who waited at a terminal of Frankfurt Airport. The terminal German Bundespolizei was able to catch the assassin."
137	02-05-2011	Attack	Osama bin Laden, leader of terrorist organization Al Qaeda, killed in a raid by U.S. Navy SEAL Team 6
138	12-07-2011	Attack	Ahmed Wali Karzai, half-brother of Afghan president Hamid Karzai. Shot twice in the head and chest by his security guard as he was coming out of his bathroom
139	22-07-2011	Attack	Anders Behring Breivik, a right-wing Norwegian, killed 77 people in a car-bomb attack in Oslo and a simultaneous attack with an automatic weapon on the island Utoya, where the youth-party of the Norwegian Socialist Party was gathered
140	March 2012	Attack	The Toulouse and Montauban shootings were a series of three gun attacks targeting Muslim French soldiers and Jewish civilians in the cities of Montauban and Toulouse in the Midi-Pyrénées region of France. In total, seven people were killed, and five others were injured, of which four seriously. The perpetrator Mohammed Merah, a 23-year-old French-Algerian Islamist, was shot and killed after a 30-hour siege with police.Merah attacked French Army personnel reportedly because of its involvement in the war in Afghanistan.

Appendix E – Summary of *The day of the Jackal*

The book *The day of the Jackal*, opens with the historical, failed attempt on the life of Charles de Gaulle, planned by Col. Jean-Marie Bastien-Thiry in the Paris suburb of Petit-Clamart. Following Bastien-Thiry's arrest, the French security forces wage a short but extremely vicious "underground" war with the terrorists of the OAS, a militant right-wing group who have labelled de Gaulle a traitor to France after his grant of independence to Algeria. The French secret service, particularly its covert operations directorate (the "Action Service"), is remarkably effective in infiltrating the terrorist organisation with their own informants, allowing them to kidnap and neutralise the terrorists' chief of operations, Antoine Argoud. The failure of the Petit-Clamart assassination, and a subsequent failed assassination attempt at the École Militaire, combined with Bastien-Thiry's execution by firing squad, cripple the morale of the OAS.

Argoud's deputy, lieutenant-colonel Marc Rodin, carefully examines their few remaining options and determines that the only way to succeed in killing de Gaulle is to hire a professional assassin from outside the organisation, someone completely unknown to both the French authorities and the OAS itself. After inquiries, he contacts an Englishman (whose name is never mentioned) who agrees to meet Rodin and his two principal deputies in Vienna. The Englishman is willing to assassinate de Gaulle for the sum total of $500,000 and the four men agree on his code name "The Jackal." The three OAS leaders then take up residency on the top floor of a Rome hotel guarded by a group of ex-legionnaires to avoid the risk of being captured like Argoud.

The remainder of Part One describes the Jackal's exhaustive preparations for the assassination. He first acquires a legitimate British passport under a false name, under which he plans to operate for the majority of his mission. He eventually steals the passports of two foreign tourists visiting London who superficially resemble the Jackal, for use in an emergency.

Using his primary false passport, the Jackal travels to Belgium, where he commissions a specialised sniper rifle of great slimness and an appropriate silencer from a master gunsmith, as well as a set of forged French identity papers from a master forger. When collecting his fake identity papers, the master forger attempts to blackmail the Jackal who kills him and hides the body in a trunk inside the forger's house. After exhaustively researching a series of books and articles by, and about, de Gaulle, the Jackal travels to Paris to determine the most favourable location and time to execute the assassination.

After orchestrating a series of armed robberies in France, the OAS are able to deposit the first half of the Jackal's fee in his bank in Switzerland. At the same time, the French secret service, curious about Rodin and his subordinates being holed up in the hotel, fake a letter that lures one of Rodin's bodyguards to France, where he is captured and interrogated. After Rodin succumbs to his wounds, the secret service interprets his incoherent ramblings and is able to piece together Rodin's plot. While Rodin gave away the codename, the secret service did not obtain enough information to identity "the Jackal".

When told about the plot, de Gaulle (who was notoriously careless of his personal safety) refuses, to cancel his public appearances, to modify his normal routines, or even to allow any kind of public inquiry into the assassin's whereabouts to be made. Any inquiry, he orders, must be done in absolute secrecy.

Roger Frey, the French Minister of the Interior, organises a meeting of the heads of the French security forces in which a Police Commissioner reasons that their first and most essential step is to establish the Jackal's identity, which is a job for a detective. When asked to name the best detective in France, he volunteers his own deputy commissioner, Claude Lebel.

Granted special emergency powers to conduct his investigation, Lebel does everything he can to discover the Jackal's identity. First, he calls upon his "old boys network" of foreign intelligence and police contacts to inquire if they have any records of a top-class political assassin. Most of the inquiries are fruitless, but in the United Kingdom, the inquiry is passed on to the Special Branch of Scotland Yard, and another veteran detective, Superintendent Bryn Thomas.

Although Special Branch's records turn up nothing, one of Thomas's subordinates suggests that if the assassin were an Englishman, but primarily operated abroad, he would most probably come to the attention of the Secret Intelligence Service (SIS). Thomas makes an informal inquiry with a friend on the SIS's staff, who mentions hearing a rumour from an officer stationed in the Dominican Republic at the time of president Trujillo's assassination. The rumour states that a hired assassin stopped Trujillo's car with a rifle shot, allowing a gang of partisans to finish him off. Moreover, the rumour is that the assassin was an Englishman, named Charles Calthrop.

To his surprise, Thomas is summoned in person by the prime-minister (unnamed), who informs him that word of his inquiries has reached higher circles in the British government. Despite the enmity felt by much of the government against France in general and Charles de Gaulle in particular, the prime-minister informs Thomas that de Gaulle is his friend, and that the assassin must be identified and stopped at all costs. Thomas is handed a mandate much similar to Lebel's, with temporary powers allowing him to override almost any other authority in the land.

Checking out the name of Charles Calthrop, Thomas finds a match to a man living in London, said to be on holiday in Scotland. While Thomas confirms that this Calthrop has been in the Dominican Republic at the time of Trujillo's death, he does not feel confident enough to inform Lebel. However, when one of his junior detectives realises that the first three letters of Calthrops' Christian name and surname form the word "Chacal" (French for Jackal), Thomas calls Lebel immediately.

Unknown to any member of the council in France, the mistress of one of them (an arrogant Air Force colonel attached to de Gaulle's staff) is actually an OAS agent. Through pillow talk, the colonel unwittingly feeds the Jackal a constant stream of information as to Lebel's progress.

The Jackal enters France by way of Italy, driving a rented Alfa Romeo sports car with his special gun hidden in the chassis. On receiving word from the OAS agent that the French are on the lookout for him, he decides his plan will succeed anyway, and forges ahead.

In London, the Special Branch raids Calthrop's flat, finding his passport, and deduce that he must be travelling on a false one. When they work out the name of the Jackal's primary false identity, Lebel and the police come close to apprehending the Jackal in the south of France. But thanks to his OAS contact, the Jackal checks out of his hotel early and evades them by only an hour.

With the police on the lookout for him, the Jackal takes refuge in the château of a woman whom he seduced while she was staying at the hotel the night before. When she goes through his things and finds the gun, he kills her and escapes again. The murder is not reported until later that evening, allowing the Jackal to assume one of his two emergency identities and board the train for Paris.

Lebel becomes suspicious of what the rest of the council labels the Jackal's "good luck", and has the telephones of all the members tapped, which leads him to discover the OAS agent. The Air Force colonel withdraws from the meeting in disgrace and later resigns from his post. When Thomas checks out and identifies reports of stolen or missing passports in London in the preceding months, he closes in on the Jackal's remaining false identities.

On the evening of 22 August 1963, Lebel deduces that the Jackal has decided to target de Gaulle on Liberation Day, on 25 August, the day commemorating the liberation of Paris during World War II. As he realises, this is the day of the year when de Gaulle can be counted on to be in Paris, and to appear in public. Assuming the inquiry is over, the Minister orchestrates a massive, citywide manhunt for the Jackal (under his false name(s)) on the charge of killing the noblewoman, and dismisses Lebel with hearty congratulations.

Despite their efforts, the Jackal eludes them yet again. By pretending to be homosexual, he allows himself to be "picked up" by another man and is taken to his apartment. The Jackal kills the man at his apartment, and remains hidden for the remaining three days, avoiding identification through hotel registrations.

On the day before August 25th 1963, the Minister summons Lebel again, and informes him the Jackal still at large. Lebel listens to the details of the President's schedule and security arrangements, and can suggest nothing more helpful than that everyone "should keep their eyes open."

On the day of the assassination, the Jackal, disguised as a one-legged French war veteran, passes through the police checkpoints, carrying his custom rifle concealed in the sections of a crutch. He makes his way to an apartment building overlooking the Place du 18 Juin 1940, where de Gaulle is presenting medals to a small group of Resistance veterans.

As the ceremony begins, Lebel is walking around the street on foot, questioning every police checkpoint. When he hears from a Compagnies Républicaines de Sécurité (CRS) officer about a one-legged veteran with a crutch, he realises what the Jackal's plan is, and rushes into the apartment building, calling for the CRS man to follow him.

In his sniper's nest, the Jackal readies his rifle and takes aim at de Gaulle's head. When de Gaulle unexpectedly leans forward to kiss the cheeks of the veteran he is honouring, the Jackal's first shot misses by a fraction of an inch. The Jackal reloads his rifle for a second shot.

Outside the apartment, Lebel and the CRS officer arrive on the top floor just in time to hear the sound of the first, silenced shot. The CRS man shoots off the lock of the door of the apartment and bursts in. The Jackal turns and fires, killing the young policeman with a shot to the chest.

At last, confronting each other, the assassin and the police detective – who had both developed grudging, mutual respect for each other in the long chase – briefly look into each other's eyes, each recognising the other for who he is. The Jackal scrambles to load his third and last rifle bullet, while Lebel, unarmed, snatches up the dead policeman's MAT-49 submachine-gun. Lebel is faster, and shoots the Jackal with half a magazine-load of bullets, instantly killing him.

This summary of the *Day of the Jackal* is based upon the summary published in the thesis *Integrating fictional art into Pandora II* (Von Bannisseht, 2014)

Summary

Narratives play an important role in human life. In fact, they are rooted so deep in human existence that narratives are at the mainstay of entertainment, law, and politics. In recent years, a growing interest has emerged to investigate the use of narratives in anticipating criminal behaviour.

In the creative sector, a narrative is generated by a scenario that describes the foreseeable interactions between characters and the system. It includes information about behaviour, goals, motivations, expectations, actions and reactions, successes and problems. While creative scenarios are widely used to help commercial organisations anticipate the behaviour of their competitor, little scholarly research is devoted to the use of scenario in the anticipation of criminal behaviour. Therefore, we have defined the research objective of this thesis is in the following problem statement: *To what extent can a scenario model support law-enforcement agencies in the anticipation of criminal behaviour?*

We intend to contribute to the discussion on anticipating criminal behaviour by two specific research activities: (1) studying the design, development, and use of an anticipative scenario model, and (2) assessing its potential to analyse and anticipate criminal behaviour. To guide our research, we have formulated four research questions:

(RQ1) *What does literature on scenario-based anticipation methods offer that is relevant for the development of a scenario model by which criminal behaviour can be anticipated?*

(RQ2) *To what extent can a scenario model be designed by which criminal behaviour can be anticipated?*

(RQ3) *To what extent can a scenario model be used to analyse historic criminal behaviour?*

(RQ4) *To what extent are data-mining techniques applied to a scenario model able to enhance the ability of law enforcements agencies to anticipate criminal behaviour?*

The answers to these four research questions will allow us to formulate an answer to the problem statement.

Chapter two forms the theoretical basis for our study. It focusses on the overarching theme and provides a deeper understanding of crime in general and criminal behaviour in particular. Drawing on literature from (a) criminology, (b) terrorism research, and (c) organisational learning, the predicaments of criminal behaviour are studied. We start with defining the concept of crime and highlight three criminal theories that offer insight into the predicaments of crime relevant to the design of an anticipative scenario model. Next, we describe the relation between organised crime and terrorism, and provide definitions of both these terms. Subsequently, we focus on "lone-operators"; criminals that operate without an organisational structure.

Because criminology indicates that a common denominator of both criminal and Terrorist organisations is their ability to learn, we conclude chapter two with a description of the concept of organisational learning and the opportunities it offers to anticipate criminal behaviour.

In chapter three RQ1 is answered by conducting a literature review of scenario based anticipatory techniques. The chapter starts with defining the terms relevant to the use of scenarios in anticipating future behaviour. Next, we review the history of scenario planning and the development of scenarios. We focus on the use of creative scenarios and the concept of the twelve components by which any scenario can be constructed. Next, three proactive models that are in use in law enforcement are highlighted to illustrate the difference with anticipative scenario models. Subsequently, the limits of anticipating future events are addressed, and the most valuable methods in relation to this thesis are highlighted. We conclude the chapter with an answer to RQ1 by highlighting the relevant findings that emerged in our literature review.

The research required to formulate an answer to RQ2, is split over the chapters four and five. Chapter four builds on the input of chapter three. First, we propose a novel manner of modelling criminal behaviour based on the creative scenarios components. We focus on the relation between a criminal offence and a theatrical performance and present a definition of the *twelve Elementary Scenario Components* (ESC12). Next, we list the ESC12 and illustrate them by using two narratives: (1) the early oral history of *The epic of Gilgamesh* and (2) the blockbuster motion picture *Jaws*. Subsequently, we introduce the ESC12 to the area of law enforcement by relating them to "the Golden W's", a concept that is frequently used in the process of information gathering as well as in law-enforcement investigations. We study the communalities and differences between the ESC12 and "the Golden W's" and arrive at the conclusion that the ESC12 offer a effective and durable set of components to describe, characterise and model a criminal incident.

In chapter five we answer RQ2 and present the design for an innovative scenario model, based on the ESC12. The chapter starts by proposing a definition of the ESC12 scenario model. Next, we distinguish the *conceptual design* of the model, from the *architectural design*. We illustrate the *conceptual design* of the ESC12 scenario model by focussing on the use of the ESC12 in (a) the ability to learn, (b) the ability to adapt, and (c) the ability to anticipate. Furthermore, we propose an *architectural design* of the ESC12 scenario model constituting four modules that facilitate six. Subsequently, we explain how these modules and processes interact with one another and how they can be combined in a scenario model with which criminal behaviour may be anticipated. Finally, we conclude that to adequately assess the proposed design of the scenario model, an experimental scenario platform needs to be constructed.

Chapter six constitutes the creation of an *Experimental Scenario Platform* (ESP) in which data of criminal behaviour is added to the architectural design of the scenario model. In the creation of the ESP, we observe that the ESC12 represent categories to broad and general to encompass the relevant details of a criminal incident. Therefore, we subdivide the ESC12 into 98 variables and introduce four variables for each category (viz. dichotomous value, numerical value, categorical value, and text value). To be able to adequately address RQ3 and RQ4 we decided to create two separate ESPs.

With RQ3 we aim to understand to what extent a scenario model may be used to detect a time-independent profile for lone-operators. For this experiment, we create ESP PANDORA I that contains detailed information on a 158 lone-operator incidents. RQ3 is answered in chapter 8.

With RQ4, we aim to understand to what extent data-mining techniques applied to the scenario model may be able to enhance the ability to anticipate criminal behaviour. For this experiment, we create ESP PANDORA II that contains information of 53,289 terrorist incidents. RQ4 is answered in chapter 9.

In chapter seven we explain the internal structure of the ESP and the process of data preparation. Eleven sections provide insight into the way data is deconstructed and implemented by four different types of variables. Every section includes a detailed table that illustrates the Elementary Scenario Component, its corresponding variables and its internal structure.

In chapter eight we answer RQ3. We study how the ESP PANDORA I may be used to analyse historic criminal behaviour. The chapter starts with an outline of the experiment and the process of case-selection. To define the timeframe of modern terrorism we introduce the *four waves of modern terrorism* concept of Rapoport (2004). Subsequently, we select 10 incidents of lone-operator terrorism per wave, and extract the ESC12 and the corresponding variables from every incident. Next, we analyse the communalities and differences between the different waves of terrorism. Subsequently, in a cross-wave analysis we accumulate the results of every wave of modern terrorism in a search for time-independent characteristics of lone-operator behaviour. From the results of this experiment, we arrive at the conclusion that a scenario model based on the ESC12 provides an opportunity to analyse historic criminal behaviour by transcending the level of individual incidents.

In chapter nine we answer RQ4. We study to what extent data-mining tools, applied to the ESP PANDORA II enhance the ability of the model to anticipate criminal behaviour. To this end, we set up three experiments in which we apply two classifiers to the ESP PANDORA II. These experiments represent three operational law enforcement situations: (1) the process of investigation of a (terrorist) incident that recently occurred (2) an active threatening situation in which a strategic location, event, or important person needs to be protected from a possible (terrorist) attack, and (3) the anticipation of future incidents. From the results of these tests we conclude that data-mining tools, applied to the ESP PANDORA II do effectively enhance the ability of the model to anticipate criminal behaviour.

In chapter ten the findings of our study are discussed and generalised to conclusions of the potential of a scenario model to anticipate criminal behaviour. By reviewing the answers to the four research questions, we arrive at our conclusion to the problem statement which reads that a scenario model can effectively support law-enforcement agencies in the anticipation of criminal behaviour to some extent. Finally, we suggest five directions for future research.

In chapter eleven (Entitled "Deleted scenes") we conduct a preliminary investigation into the possibilities of text mining; a subject that did not seem to fit the Ph.D. research, yet is believed to offer a valuable addition to this thesis (hence the title of the chapter).

As we argued in the previous chapters, there seems to be a strong analogy between a theatrical performance and a terrorist act. This analogy provides us with the opportunity to add creative narratives to the ESC12 scenario model. Therefore, we designed an experiment in which we study two claims: (1) *Combining data from terrorist incidents with data from works of fiction would enhance the potential of the ESC12 scenario model*. (2) *Text-mining techniques would enable the automatic extraction of the ESC12 variables from works of fiction*. To address the first claim, we investigate the nexus between terroristic and creative narratives by drawing on related scientific studies. To investigate the second claim, we conduct a text mining experiment in which we apply text-mining rules on thirteen novels that were written by Frederick Forsyth. Based on the results of our investigations, we arrive at the conclusion that adding the ESC12 (variables) by means of text mining from works of fiction, would enhance the capabilities of the ESC12 scenario model. Based on this conclusion we build a sneak preview of the future of the ESC12 scenario model.

Samenvatting

Verhalen spelen een belangrijke rol in intermenselijke relaties. In feite zijn verhalen zó diep geworteld in het menselijk bestaan, dat entertainment, recht, en politiek in belangrijke mate worden bepaald door verhalen. De laatste jaren is er een groeiende interesse ontstaan in de rol van het verhaal in het voorkomen van crimineel gedrag.

Binnen de creatieve sector wordt een verhaal beschreven aan de hand van een scenario. Een scenario beschrijft interacties tussen de personages en het systeem, en bevat informatie over gedrag, doelen, motivaties, verwachtingen, acties en reacties, successen en problemen.

Sinds het begin van de twintigste eeuw worden creatieve scenario's door commerciële organisaties ingezet om gedrag van concurrenten te voorspellen. Hoewel reeds vele (wetenschappelijke) publicaties over dit onderwerp zijn verschenen, is het gebruik van scenario's in het voorzien van crimineel gedrag een relatief nieuw onderwerp van onderzoek. Vandaar dat we voor deze thesis voor de volgende probleemstelling hebben gekozen: *In hoeverre kan een scenario model opsporings-organisaties ondersteunen in het anticiperen van crimineel gedrag?*

Middels dit onderzoek dragen we bij aan de discussie over het anticiperen op crimineel gedrag door middel van twee specifieke onderzoeksactiviteiten: (1) het bestuderen en ontwikkelen van een proactief scenario model, en (2) het evalueren van het vermogen van dit model om op crimineel gedrag te anticiperen. Om dit onderzoek richting te geven, hebben we vier onderzoeksvragen (RQs) geformuleerd:
(RQ1) *Wat is er in de literatuur bekend over anticiperende scenario modellen, dat relevant is in de ontwikkeling van een proactief scenario model?*
(RQ2) *In welke mate kan een scenario model ontworpen worden waarmee kan worden geanticipeerd op crimineel gedrag?*
(RQ3) *In hoeverre kan een scenario model worden aangewend om historisch crimineel gedrag te analyseren?*
(RQ4) *In hoeverre kunnen datamining technieken, toegepast op een scenario model, het vermogen van opsporingsinstanties verbeteren om te anticiperen op crimineel gedrag?*

De antwoorden op deze vier onderzoeksvragen helpen ons een antwoord te formuleren op de probleemstelling.

Hoofdstuk twee vormt de theoretische basis voor ons onderzoek. Het richt zich op het overkoepelende thema en biedt inzicht in criminaliteit in het algemeen, en crimineel gedrag in het bijzonder. Op basis van literatuur op het gebied van (a) criminologie, (b) terrorismeonderzoek, en (c) lerende organisaties, worden de kenmerken van crimineel gedrag bestudeerd. We definiëren het begrip criminaliteit en bestuderen drie relevante criminologische theorieën. We richten ons op de relatie tussen georganiseerde criminaliteit en terrorisme, en presenteren definities voor beide termen. Vervolgens onderzoeken we "lone-operators"; criminelen die opereren buiten een organisatiestructuur.

Omdat het "lerend vermogen" een bepalende factor blijkt te zijn voor zowel criminele als terroristische organisaties, sluiten we dit hoofdstuk af met een beschrijving van "organisational learning" en de mogelijkheden daarvan met betrekking tot het anticiperen op crimineel gedrag.

Hoofdstuk drie beschrijft de beantwoording van RQ1 aan de hand van een literatuuronderzoek naar anticiperende scenario methodieken. Het hoofdstuk begint met het definiëren van de relevante termen. Vervolgens richten we ons op de geschiedenis van scenarioplanning en op de ontwikkeling van scenario's. We besteden aandacht aan het gebruik van creatieve scenario's en aan het concept van de twaalf componenten waarmee elk scenario kan worden geconstrueerd. Voorts worden drie proactieve modellen beschreven die in gebruik zijn binnen de opsporing, en wordt het verschil hiervan met anticiperende scenario modellen geduid. De grenzen van het anticiperen op toekomstig gedrag worden beschreven, en de meest waardevolle scenario methoden met betrekking tot dit proefschrift worden aangehaald. We sluiten het hoofdstuk af met een antwoord op RQ1.

Het onderzoek dat vereist is voor beantwoording van RQ2, is verdeeld over de hoofdstukken vier en vijf. In hoofdstuk vier wordt een nieuwe manier van modelleren van crimineel gedrag voorgesteld, gebaseerd op de creatieve scenario componenten die in hoofdstuk drie werden geïntroduceerd. Allereerst richten we ons op de overeenkomst tussen een misdrijf en een film- of theaterproductie, en presenteren we de definitie van de *twaalf Elementaire Scenario Componenten*

(ESC12). Daarna illustreren we de rol van de ESC12 aan de hand van twee verhalen: (1) het klassieke epos van *Gilgamesj* en (2) de bioscoopfilm *Jaws*. Vervolgens vergelijken we de ESC12 met "de Gouden W's", een begrip dat vaak wordt gebruikt in het proces van informatieverzameling. Op basis van deze vergelijking concluderen we dat de ESC12 een duurzame set van componenten biedt waarmee crimineel gedrag effectief kan worden gemodelleerd en beschreven. Op basis van deze conclusie, besluiten we de ESC12 te implementeren in het ontwerp van een scenario model waarmee op crimineel gedrag kan worden geanticipeerd.

In hoofdstuk vijf beantwoorden we RQ2 en presenteren we het ontwerp voor een innovatief scenario model, gebaseerd op de ESC12. Het hoofdstuk begint met de definitie van een ESC12 scenario model. Voorts onderscheiden we het *conceptuele* ontwerp van het scenario model, van het *architectonische* ontwerp. Voor het *conceptuele* ontwerp richten we ons op het gebruik van de ESC12 in relatie tot (a) het vermogen om te leren, (b) het vermogen tot aanpassing aan veranderende situaties, en (c) het vermogen om te anticiperen. Voor het *architectonisch* ontwerp van het ESC12 scenario model bestuderen we de integratie van vier modules en zes processen. We leggen uit hoe deze modules en processen met elkaar samen gebracht kunnen worden in één model, en presenteren een blueprint voor het ontwerp van een ESC12 scenario model. Tot slot concluderen we dat voor het testen van het voorgesteld ontwerp, een Experimenteel Scenario Platform moet worden gecreëerd.

Hoofdstuk zes beschrijft de totstandkoming van het *Experimenteel Scenario Platform* (ESP) waarin gegevens van crimineel gedrag worden toegevoegd aan de architectonische vormgeving van het scenario model. Omdat we hebben geconcludeerd dat de ESC12 componenten te breed zijn om alle relevante details van een crimineel incident te omvatten, verdelen we de ESC12 in 98 variabelen. Vervolgens creëren we twee verschillende ESP's voor de beantwoording van de resterende onderzoeksvragen RQ3 en RQ4.
RQ3 richt zich op de vraag in hoeverre een scenario model kan worden gebruikt om een tijds- onafhankelijk profiel voor lone-operators te detecteren. Voor dit experiment creëren we ESP PANDORA I dat gedetailleerde informatie bevat over een 157 lone-operator incidenten. RQ3 wordt beantwoord in hoofdstuk acht.
RQ4, richt zich op de vraag in welke mate datamining technieken in staat zijn om het anticiperend vermogen van het scenario model te versterken. Voor dit

experiment, creëren we ESP PANDORA II dat gegevens bevat van 53.289 terroristische incidenten. RQ4 wordt beantwoord in hoofdstuk negen.

In hoofdstuk zeven beschrijven we de interne structuur van de ESP PANDORA en verdelen we de ESC12 onder in 98 variabelen. Daarnaast biedt dit hoofdstuk inzicht in de manier waarop data in het ESC12 scenario model wordt ingebracht.

In hoofdstuk acht beantwoorden we RQ3. Aan de hand van een experiment bestuderen we hoe ESP PANDORA I gebruikt kan worden voor de analyse van lone-operator terrorisme. Het hoofdstuk begint met een uitleg van het experiment en het proces van case-selection. We introduceren de *Four waves of modern terrorism* theorie van Rapoport (2004), en verdelen veertig incidenten van lone-operator terrorisme aan de hand van deze tijdsindeling. Vervolgens bestuderen we de overeenkomsten en verschillen tussen de incidenten van elke wave, en brengen we de resultaten van de vier waves bij elkaar. Gebaseerd op de resultaten van dit experiment concluderen we dat een scenario gebaseerd op de ESC12, mogelijkheden biedt om historisch crimineel gedrag te kunnen analyseren.

In hoofdstuk negen beantwoorden we RQ4. We onderzoeken in hoeverre datamining tools, toegepast op de dataset van ESP PANDORA II het vermogen van het model verbeteren om crimineel gedrag te voorspellen. We zetten daartoe een vergelijkend onderzoek op waarin we twee datamining classifiers toepassen op de ESP PANDORA II: de ZeroR classifier die we gebruiken als baseline, en de J48 decision tree. Met deze classifiers voeren we drie experimenten uit die verschillende operationele situaties in de opsporing vertegenwoordigen: (1) het onderzoek van een terroristisch incident dat zich recentelijk heeft voorgedaan, (2) een actuele bedreigende situatie waarin een strategische locatie, evenement of belangrijk persoon moet worden beschermd tegen een mogelijke terroristische aanslag, en (3) het anticiperen op toekomstige terroristische aanslagen. Gebaseerd op de resultaten van dit experiment concluderen we dat datamining tools, toegepast op de ESP PANDORA II het vermogen versterken om crimineel gedrag te voorspellen.

In hoofdstuk tien worden de resultaten van onze research besproken en gegeneraliseerd naar conclusies over het potentieel van een ESC12 scenario model om crimineel gedrag te anticiperen. De beantwoording van de vier onderzoeksvragen leidt ons naar vier conclusies. Op basis van deze conclusies formuleren we een antwoord op de probleemstelling. Ter afsluiting van dit hoofdstuk doen we vijf aanbevelingen voor toekomstig onderzoek.

Hoofdstuk elf ("Deleted scenes") is als uitbreiding van ons onderzoek aan dit proefschrift toegevoegd, omdat de vraag ontstond of tekst-mining technieken kunnen voorzien in de automatische extractie van de ESC12 (variabelen) uit werken van fictie. Omdat dit onderwerp niet past binnen de doelstelling van ons onderzoek, maar hier desondanks een waardevolle aanvulling op biedt, behandelen we dit onderwerp in een extra hoofdstuk.

Zoals in de vorige hoofdstukken is betoogd, lijkt er een sterke analogie te bestaan tussen een creatief narratief en een terroristisch narratief. Deze analogie biedt ons de mogelijkheid om creatieve verhalen toe te voegen aan het ESC12 scenario model. Om de mogelijkheden hiertoe te onderzoeken hebben we twee claims geformuleerd: (1) Het combineren van gegevens uit terroristische incidenten met gegevens uit werken van fictie verbeteren het potentieel van het ESC12 scenario model. (2) Tekst-mining technieken kunnen voorzien in de automatische extractie van de ESC12 variabelen uit werken van fictie. Ter toetsing van eerstgenoemde claim, onderzoeken we het verband tussen het terroristisch en creatieve narratief aan de hand van verwante wetenschappelijke studies. Om de tweede claim te toetsen, voeren we een experiment uit waarin we tekst-mining regels toepassen op dertien romans van Frederick Forsyth. De resultaten van onze onderzoeken, leiden ons tot de conclusie dat het abstraheren van de ESC12 (variabelen) door middel van tekst-mining technieken, de mogelijkheden van het ESC12 scenario model daadwerkelijk vergroot. Aan de hand van deze conclusie formuleren we een 'sneak preview' van de toekomst van het ESC12 scenario model.

Curriculum Vitae

Peter de Kock was born in 1967 in Maastricht. After completing his secondary education (MAVO, HAVO), he studied Audio-visual design and photography at the Hogeschool Katholieke Leergangen Sittard, where he graduated with honours in 1990.

From 1990 to 1994 he studied at the Netherlands Film Academy (Amsterdam School of the Arts) where he obtained his Bachelor of Arts degree. Following this study, he worked as a professional photographer, cameraman and film director. His work as a filmmaker provided the opportunity to travel extensively, and included the coverage of conflicts and crisis situations in countries such as Mali, Yemen, Burundi, Sierra Leone, Columbia, and Ingushetia. As a filmmaker he attributed to several prize-winning documentaries and film productions. With his feature length documentary film *The Hands of Che Guevara*, he earned international acclaim.

In 2009 he earned a Master degree in Criminal Investigation. Following this study he was given the opportunity to create and lead a novel specialist team within the Dutch National Police force. The thought-provoking results of this team prompted the interest of law enforcement and governmental organisations in the applied method of operation.

The opportunity to pursue a Ph.D. at Tilburg University provided a chance to combine previous studies with professional experience, both as a film director and as a team leader within Dutch National Police.

Currently, Peter is working as head of a covert unit of the Dutch National Police.

Acknowledgements

In the preface, it was mentioned that this thesis reflects a rather unorthodox combination of fine art, science and law enforcement. While these disciplines may seem segregated by different attitudes, opinions, and temperaments, I found a common denominator in the people I've been working with: the artists, scientists, and law-enforcement officials that helped me complete my thesis, share an intrinsic appreciation for re-examination. Now that I have arrived at the end of this journey, I would like to take the opportunity to express my gratitude to them.

In addition to the recognition expressed in the preface, I would like to convey my personal gratefulness and deep respect for my supervisors Jaap van den Herik, Jan Scholtes, and Pieter Spronck. Their guidance, support, and belief in me have been a crucial factor in the completion of this thesis. Jaap was the first to recognise scientific potential in my ideas, and to see beauty at the intersection of art, science and law enforcement. He has been a constant support on this journey, regardless of the fact that I embarked on it from quite an unusual background. Jan hospitably offered his help and that of his company ZyLAB and introduced me to the world of text mining. I greatly appreciate Jan's openness and enthusiasm. Pieter's help has proved to be essential in bridging the gap between policing and science. His guidance and creativity have helped me define the area of my research.

Moreover, Ron Boelsma has been a crucial factor. Ron introduced me to valuable people in his law-enforcement network and in doing so took the role of godfather of this project. His ability to anticipate what is coming, and to connect people accordingly, has been instrumental in my research.

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On a personal level, I wish to thank the people that are closest to me. I would like to thank my close friends for the distraction and perspectives they provide. Only a few people in this world know what the anagram LAOBAM refers to, and I sincerely hope we will continue to appreciate this tradition until our dying days.

Moreover, I would like to express my appreciation and gratitude to Marianne, my close companion in life, and to our sons Ruben and 'Tex'. I sincerely thank you for your love, support and patience. Your views on life are a constant source of inspiration to me.

My lifelong gratitude goes towards my parents who have raised me with the notion that nearly everything is possible, as long as you stay close to your heart. If anything, this thesis is the proof that you were right all the time.

Peter de Kock
Amsterdam, September 2014.

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15. Martijn van Otterlo (UT) *The Logic of Adaptive Behavior: Knowledge Representation and Algorithms for the Markov Decision Process Framework in First-Order Domains*
16. Henriette van Vugt (VU) *Embodied agents from a user's perspective*
17. Martin Op 't Land (TUD) *Applying Architecture and Ontology to the Splitting and Allying of Enterprises*
18. Guido de Croon (UM) *Adaptive Active Vision*
19. Henning Rode (UT) *From Document to Entity Retrieval: Improving Precision and Performance of Focused Text Search*
20. Rex Arendsen (UvA) *Geen bericht, goed bericht. Een onderzoek naar de effecten van de introductie van elektronisch berichtenverkeer met de overheid op de administratieve lasten van bedrijven*
21. Krisztian Balog (UvA) *People Search in the Enterprise*
22. Henk Koning (UU) *Communication of IT-Architecture*
23. Stefan Visscher (UU) *Bayesian network models for the management of ventilator-associated pneumonia*
24. Zharko Aleksovski (VU) *Using background knowledge in ontology matching*
25. Geert Jonker (UU) *Efficient and Equitable Exchange in Air Traffic Management Plan Repair using Spender-signed Currency*
26. Marijn Huijbregts (UT) *Segmentation, Diarization and Speech Transcription: Surprise Data Unraveled*
27. Hubert Vogten (OU) *Design and Implementation Strategies for IMS Learning Design*
28. Ildiko Flesch (RUN) *On the Use of Independence Relations in Bayesian Networks*
29. Dennis Reidsma (UT) *Annotations and Subjective Machines - Of Annotators, Embodied Agents, Users, and Other Humans*
30. Wouter van Atteveldt (VU) *Semantic Network Analysis: Techniques for Extracting, Representing and Querying Media Content*
31. Loes Braun (UM) *Pro-Active Medical Information Retrieval*
32. Trung H. Bui (UT) *Toward Affective Dialogue Management using Partially Observable Markov Decision Processes*
33. Frank Terpstra (UvA) *Scientific Workflow Design; theoretical and practical issues*
34. Jeroen de Knijf (UU) *Studies in Frequent Tree Mining*
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2009

1. Rasa Jurgelenaite (RUN) *Symmetric Causal Independence Models*
2. Willem Robert van Hage (VU) *Evaluating Ontology-Alignment Techniques*

3. Hans Stol (UvT) *A Framework for Evidence-based Policy Making Using IT*
4. Josephine Nabukenya (RUN) *Improving the Quality of Organisational Policy Making using Collaboration Engineering*
5. Sietse Overbeek (RUN) *Bridging Supply and Demand for Knowledge Intensive Tasks - Based on Knowledge, Cognition, and Quality*
6. Muhammad Subianto (UU) *Understanding Classification*
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8. Volker Nannen (VU) *Evolutionary Agent-Based Policy Analysis in Dynamic Environments*
9. Benjamin Kanagwa (RUN) *Design, Discovery and Construction of Service-oriented Systems*
10. Jan Wielemaker (UvA) *Logic programming for knowledge-intensive interactive applications*
11. Alexander Boer (UvA) *Legal Theory, Sources of Law & the Semantic Web*
12. Peter Massuthe (TU/e), Humboldt-Universitaet zu Berlin) *Operating Guidelines for Services*
13. Steven de Jong (UM) *Fairness in Multi-Agent Systems*
14. Maksym Korotkiy (VU) *From ontology-enabled services to service-enabled ontologies (making ontologies work in e-science with ONTO-SOA)*
15. Rinke Hoekstra (UvA) *Ontology Representation - Design Patterns and Ontologies that Make Sense*
16. Fritz Reul (UvT) *New Architectures in Computer Chess*
17. Laurens van der Maaten (UvT) *Feature Extraction from Visual Data*
18. Fabian Groffen (CWI) *Armada, An Evolving Database System*
19. Valentin Robu (CWI) *Modeling Preferences, Strategic Reasoning and Collaboration in Agent-Mediated Electronic Markets*
20. Bob van der Vecht (UU) *Adjustable Autonomy: Controling Influences on Decision Making*
21. Stijn Vanderlooy (UM) *Ranking and Reliable Classification*
22. Pavel Serdyukov (UT) *Search For Expertise: Going beyond direct evidence*
23. Peter Hofgesang (VU) *Modelling Web Usage in a Changing Environment*
24. Annerieke Heuvelink (VU) *Cognitive Models for Training Simulations*
25. Alex van Ballegooij (CWI) *"RAM: Array Database Management through Relational Mapping"*
26. Fernando Koch (UU) *An Agent-Based Model for the Development of Intelligent Mobile Services*
27. Christian Glahn (OU) *Contextual Support of social Engagement and Reflection on the Web*
28. Sander Evers (UT) *Sensor Data Management with Probabilistic Models*
29. Stanislav Pokraev (UT) *Model-Driven Semantic Integration of Service-Oriented Applications*
30. Marcin Zukowski (CWI) *Balancing vectorized query execution with bandwidth-optimized storage*
31. Sofiya Katrenko (UvA) *A Closer Look at Learning Relations from Text*
32. Rik Farenhorst (VU) and Remco de Boer (VU) *Architectural Knowledge Management: Supporting Architects and Auditors*
33. Khiet Truong (UT) *How Does Real Affect Affect Affect Recognition In Speech?*
34. Inge van de Weerd (UU) *Advancing in Software Product Management: An Incremental Method Engineering Approach*
35. Wouter Koelewijn (UL) *Privacy en Politiegegevens; Over geautomatiseerde normatieve informatie-uitwisseling*
36. Marco Kalz (OUN) *Placement Support for Learners in Learning Networks*
37. Hendrik Drachsler (OUN) *Navigation Support for Learners in Informal Learning Networks*
38. Riina Vuorikari (OU) *Tags and self-organisation: a metadata ecology for learning resources in a multilingual context*
39. Christian Stahl (TU/e), Humboldt-Universitaet zu Berlin) *Service Substitution - A Behavioral Approach Based on Petri Nets*
40. Stephan Raaijmakers (UvT) *Multinomial Language Learning: Investigations into the Geometry of Language*
41. Igor Berezhnyy (UvT) *Digital Analysis of Paintings*
42. Toine Bogers (UvT) *Recommender Systems for Social Bookmarking*

43. Virginia Nunes Leal Franqueira (UT) *Finding Multi-step Attacks in Computer Networks using Heuristic Search and Mobile Ambients*
44. Roberto Santana Tapia (UT) *Assessing Business-IT Alignment in Networked Organizations*
45. Jilles Vreeken (UU) *Making Pattern Mining Useful*
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2. Ingo Wassink (UT) *Work flows in Life Science*
3. Joost Geurts (CWI) *A Document Engineering Model and Processing Framework for Multimedia documents*
4. Olga Kulyk (UT) *Do You Know What I Know? Situational Awareness of Co-located Teams in Multidisplay Environments*
5. Claudia Hauff (UT) *Predicting the Effectiveness of Queries and Retrieval Systems*
6. Sander Bakkes (UvT) *Rapid Adaptation of Video Game AI*
7. Wim Fikkert (UT) *Gesture interaction at a Distance*
8. Krzysztof Siewicz (UL) *Towards an Improved Regulatory Framework of Free Software. Protecting user freedoms in a world of software communities and eGovernments*
9. Hugo Kielman (UL) *A Politiele gegevensverwerking en Privacy, Naar een effectieve waarborging*
10. Rebecca Ong (UL) *Mobile Communication and Protection of Children*
11. Adriaan Ter Mors (TUD) *The world according to MARP: Multi-Agent Route Planning*
12. Susan van den Braak (UU) *Sensemaking software for crime analysis*
13. Gianluigi Folino (RUN) *High Performance Data Mining using Bio-inspired techniques*
14. Sander van Splunter (VU) *Automated Web Service Reconfiguration*
15. Lianne Bodenstaff (UT) *Managing Dependency Relations in Inter-Organizational Models*
16. Sicco Verwer (TUD) *Efficient Identification of Timed Automata, theory and practice*
17. Spyros Kotoulas (VU) *Scalable Discovery of Networked Resources: Algorithms, Infrastructure, Applications*
18. Charlotte Gerritsen (VU) *Caught in the Act: Investigating Crime by Agent-Based Simulation*
19. Henriette Cramer (UvA) *People's Responses to Autonomous and Adaptive Systems*
20. Ivo Swartjes (UT) *Whose Story Is It Anyway? How Improv Informs Agency and Authorship of Emergent Narrative*
21. Harold van Heerde (UT) *Privacy-aware data management by means of data degradation*
22. Michiel Hildebrand (CWI) *End-user Support for Access to\\ Heterogeneous Linked Data*
23. Bas Steunebrink (UU) *The Logical Structure of Emotions*
24. Dmytro Tykhonov (TUD) *Designing Generic and Efficient Negotiation Strategies*
25. Zulfiqar Ali Memon (VU) *Modelling Human-Awareness for Ambient Agents: A Human Mindreading Perspective*
26. Ying Zhang (CWI) *XRPC: Efficient Distributed Query Processing on Heterogeneous XQuery Engines*
27. Marten Voulon (UL) *Automatisch contracteren*
28. Arne Koopman (UU) *Characteristic Relational Patterns*
29. Stratos Idreos(CWI) *Database Cracking: Towards Auto-tuning Database Kernels*
30. Marieke van Erp (UvT) *Accessing Natural History - Discoveries in data cleaning, structuring, and retrieval*
31. Victor de Boer (UvA) *Ontology Enrichment from Heterogeneous Sources on the Web*
32. Marcel Hiel (UvT) *An Adaptive Service Oriented Architecture: Automatically solving Interoperability Problems*
33. Robin Aly (UT) *Modeling Representation Uncertainty in Concept-Based Multimedia Retrieval*
34. Teduh Dirgahayu (UT) *Interaction Design in Service Compositions*
35. Dolf Trieschnigg (UT) *Proof of Concept: Concept-based Biomedical Information Retrieval*

36. Jose Janssen (OU) *Paving the Way for Lifelong Learning; Facilitating competence development through a learning path specification*
37. Niels Lohmann (TU/e) *Correctness of services and their composition*
38. Dirk Fahland (TU/e) *From Scenarios to components*
39. Ghazanfar Farooq Siddiqui (VU) *Integrative modeling of emotions in virtual agents*
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2011

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3. Jan Martijn van der Werf (TU/e) *Compositional Design and Verification of Component-Based Information Systems*
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5. Base van der Raadt (VU) *Enterprise Architecture Coming of Age - Increasing the Performance of an Emerging Discipline.*
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9. Tim de Jong (OU) *Contextualised Mobile Media for Learning*
10. Bart Bogaert (UvT) *Cloud Content Contention*
11. Dhaval Vyas (UT) *Designing for Awareness: An Experience-focused HCI Perspective*
12. Carmen Bratosin (TU/e) *Grid Architecture for Distributed Process Mining*
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14. Milan Lovric (EUR) *Behavioral Finance and Agent-Based Artificial Markets*
15. Marijn Koolen (UvA) *The Meaning of Structure: the Value of Link Evidence for Information Retrieval*
16. Maarten Schadd (UM) *Selective Search in Games of Different Complexity*
17. Jiyin He (UvA) *Exploring Topic Structure: Coherence, Diversity and Relatedness*
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21. Linda Terlouw (TUD) *Modularization and Specification of Service-Oriented Systems*
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24. Herwin van Welbergen (UT) *Behavior Generation for Interpersonal Coordination with Virtual Humans On Specifying, Scheduling and Realizing Multimodal Virtual Human Behavior*
25. Syed Waqar ul Qounain Jaffry (VU) *Analysis and Validation of Models for Trust Dynamics*
26. Matthijs Aart Pontier (VU) *Virtual Agents for Human Communication - Emotion Regulation and Involvement-Distance Trade-Offs in Embodied Conversational Agents and Robots*
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29. Faisal Kamiran (TU/e) *Discrimination-aware Classification*
30. Egon van den Broek (UT) *Affective Signal Processing (ASP): Unraveling the mystery of emotions*
31. Ludo Waltman (EUR) *Computational and Game-Theoretic Approaches for Modeling Bounded Rationality*
32. Nees-Jan van Eck (EUR) *Methodological Advances in Bibliometric Mapping of Science*
33. Tom van der Weide (UU) *Arguing to Motivate Decisions*
34. Paolo Turrini (UU) *Strategic Reasoning in Interdependence: Logical and Game-theoretical Investigations*
35. Maaike Harbers (UU) *Explaining Agent Behavior in Virtual Training*
36. Erik van der Spek (UU) *Experiments in serious game design: a cognitive approach*
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38. Nyree Lemmens (UM) *Bee-inspired Distributed Optimization*
39. Joost Westra (UU) *Organizing Adaptation using Agents in Serious Games*
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42. Michal Sindlar (UU) *Explaining Behavior through Mental State Attribution*
43. Henk van der Schuur (UU) *Process Improvement through Software Operation Knowledge*
44. Boris Reuderink (UT) *Robust Brain-Computer Interfaces*
45. Herman Stehouwer (UvT) *Statistical Language Models for Alternative Sequence Selection*
46. Beibei Hu (TUD) *Towards Contextualized Information Delivery: A Rule-based Architecture for the Domain of Mobile Police Work*
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3. Adam Vanya (VU) *Supporting Architecture Evolution by Mining Software Repositories*
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9. Ricardo Neisse (UT) *Trust and Privacy Management Support for Context-Aware Service Platforms*
10. David Smits (TU/e) *Towards a Generic Distributed Adaptive Hypermedia Environment*
11. J.C.B. Rantham Prabhakara (TU/e) *Process Mining in the Large: Preprocessing, Discovery, and Diagnostics*
12. Kees van der Sluijs (TU/e) *Model Driven Design and Data Integration in Semantic Web Information Systems*
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15. Natalie van der Wal (VU) *Social Agents. Agent-Based Modelling of Integrated Internal and Social Dynamics of Cognitive and Affective Processes.*
16. Fiemke Both (VU) *Helping people by understanding them - Ambient Agents supporting task execution and depression treatment*
17. Amal Elgammal (UvT) *Towards a Comprehensive Framework for Business Process Compliance*
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19. Helen Schonenberg (TU/e) *What's Next? Operational Support for Business Process Execution*
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2013

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16. Eric Kok (UU) *Exploring the practical benefits of argumentation in multi-agent deliberation*
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10. Ivan Salvador Razo Zapata (VU) *Service Value Networks*
11. Janneke van der Zwaan (TUD) *An Empathic Virtual Buddy for Social Support*
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16. Krystyna Milian (VU) *Supporting Trial Recruitment and Design by Automatically Interpreting Eligibility Criteria*
17. Kathrin Dentler (VU) *Computing Healthcare Quality Indicators Automatically: Secondary Use of Patient Data and Semantic Interoperability*
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22. Marieke Peeters (UT) *Personalized Educational Games - Developing Agent-Supported Scenario-based Training*
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26. Tim Baarslag (TUD) *What to Bid and When to Stop*
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11. Sander Bakkes. Rapid Adaptation of Video Game AI. Promotor: H.J. van den Herik. Co-promotor: P. Spronck. Tilburg, 3 March 2010.
12. Maria Mos. Complex Lexical Items. Promotor: A.P.J. van den Bosch. Co-promotores: A. Vermeer, A. Backus. Tilburg, 12 May 2010 (in collaboration with the Department of Language and Culture Studies).
13. Marieke van Erp. Accessing Natural History. Discoveries in data cleaning, structuring, and retrieval. Promotor: A.P.J. van den Bosch. Co-promotor: P.K. Lendvai. Tilburg, 30 June 2010.
14. Edwin Commandeur. Implicit Causality and Implicit Consequentiality in Language Comprehension. Promotores: L.G.M. Noordman, W. Vonk. Co-promotor: R. Cozijn. Tilburg, 30 June 2010.
15. Bart Bogaert. Cloud Content Contention. Promotores: H.J. van den Herik, E.O. Postma. Tilburg, 30 March 2011.
16. Xiaoyu Mao. Airport under Control. Promotores: H.J. van den Herik, E.O. Postma. Co-promotores: N. Roos, A. Salden. Tilburg, 25 May 2011.
17. Olga Petukhova. Multidimensional Dialogue Modelling. Promotor: H. Bunt. Tilburg, 1 September 2011.
18. Lisette Mol. Language in the Hands. Promotores: E.J. Krahmer, F. Maes, M.G.J. Swerts. Tilburg, 7 November 2011 (cum laude).
19. Herman Stehouwer. Statistical Language Models for Alternative Sequence Selection. Promotores: A.P.J. van den Bosch, H.J. van den Herik. Co-promotor: M.M. van Zaanen. Tilburg, 7 December 2011.
20. Terry Kakeeto-Aelen. Relationship Marketing for SMEs in Uganda. Promotores: J. Chr. van Dalen, H.J. van den Herik. Co-promotor: B.A. Van de Walle. Tilburg, 1 February 2012.
21. Suleman Shahid. Fun & Face: Exploring non-verbal expressions of emotion during playful interactions. Promotores: E.J. Krahmer, M.G.J. Swerts. Tilburg, 25 May 2012.

22. Thijs Vis. Intelligence, Politie en Veiligheidsdienst: Verenigbare Grootheden? Promotores: T.A. de Roos, H.J. van den Herik, A.C.M. Spapens. Tilburg, 6 June 2012 (in collaboration with the Tilburg School of Law).
23. Nancy Pascall. Engendering Technology Empowering Women. Promotores: H.J. van den Herik, M. Diocaretz. Tilburg, 19 November 2012.
24. Agus Gunawan. Information Access for SMEs in Indonesia. Promotor: H.J. van den Herik. Co-promotores: M. Wahdan, B.A. Van de Walle. Tilburg, 19 December 2012.
25. Giel van Lankveld. Quantifying Individual Player Differences. Promotores: H.J. van den Herik, A.R. Arntz. Co-promotor: P. Spronck. Tilburg, 27 February 2013.
26. Sander Wubben. Text-to-text Generation Using Monolingual Machine Translation. Promotores: E.J. Krahmer, A.P.J. van den Bosch, H. Bunt. Tilburg, 5 June 2013.
27. Jeroen Janssens. Outlier Selection and One-Class Classification. Promotores: E.O. Postma, H.J. van den Herik. Tilburg, 11 June 2013.
28. Martijn Balsters. Expression and Perception of Emotions: The Case of Depression, Sadness and Fear. Promotores: E.J. Krahmer, M.G.J. Swerts, A.J.J.M. Vingerhoets. Tilburg, 25 June 2013.
29. Lisanne van Weelden. Metaphor in Good Shape. Promotor: A.A. Maes. Co-promotor: J. Schilperoord. Tilburg, 28 June 2013.
30. Ruud Koolen. "Need I say More? On Overspecification in Definite Reference." Promotores: E.J. Krahmer, M.G.J. Swerts. Tilburg, 20 September 2013.
31. J. Douglas Mastin. Exploring Infant Engagement. Language Socialization and Vocabulary. Development: A Study of Rural and Urban Communities in Mozambique. Promotor: Prof.dr. A.A. Maes. Co-promotor: Dr. P.A. Vogt. Tilburg, 11 October 2013.
32. Philip C. Jackson. Jr. *Toward Human-Level Artificial Intelligence – Representation and Computation of Meaning in Natural Language*. Promotores: H.C. Bunt, W.P.M. Daelemans. Tilburg, 22 April 2014.
33. Jorrig Vogels. *Referential choices in language production: The Role of Accessibility.* Promotores: A.A. Maes, E.J. Krahmer. Tilburg, 23 April 2014.
34. Peter de Kock. *Anticipating Criminal Behaviour.* Promotores: H.J. van den Herik, J.C. Scholtes. Co-promotor: P. Spronck. Tilburg, 10 September 2014.